Field Sampling Plan Addendum No. 1 – Former Fuel Distribution System ("FDS") Closure Phases II and III, Infantry Terrace (FDS Section MT-14) Area

Presidio of San Francisco
California

6 February 2008

Prepared By:

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EKI A70004.16

6 February 2008

Mr. Devender Narala
Regional Water Quality Control Board
1515 Clay Street, Suite 1400
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Subject: **Field Sampling Plan Addendum No. 1 – Former Fuel Distribution System ("FDS") Closure Phases II and III, Infantry Terrace (FDS Section MT-14) Area Presidio of San Francisco, California**

Dear Mr. Narala:

The Presidio Trust ("Trust") is pleased to submit to the Regional Water Quality Control Board, San Francisco Bay Region ("Water Board") the enclosed report, referenced above. The Trust has prepared this Field Sampling Plan Addendum ("FSP Addendum") for soil sampling and chemical analysis from 21 proposed locations along with the installation and sampling of four proposed groundwater monitoring wells within the former in the Infantry Terrace (FDS Section MT-14) Area.

Please contact me at (415) 561-4259 if you have any questions.

Sincerely yours,
The Presidio Trust

Eileen Fanelli

Eileen Fanelli
Remediation Program Manager

Enclosure

cc:

Brian Ullensvang, National Park Service ("NPS")
Bob Boggs, California Department of Toxic Substances Control ("DTSC")
Doug Kern, Restoration Advisory Board ("RAB")
Mark Youngkin, RAB (without enclosure)

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6 February 2008

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Subject: **Field Sampling Plan Addendum – Former Fuel Distribution System Closure Phases II and III, Infantry Terrace (FDS Section MT-14) Area, Presidio of San Francisco, California**
(EKI A70004.16)

Dear Ms. Fanelli:

On behalf of the Presidio Trust ("Trust"), Erler & Kalinowski, Inc. ("EKI") has prepared this Field Sampling Plan Addendum ("FSP Addendum") to the *Field Sampling Plan – Former Fuel Distribution System ("FDS") Closure Phases II and III at the Presidio of San Francisco* ("FSP") dated 27 April 2007.[1] This FSP Addendum has been prepared in response to comments and requests made during the 27 February 2007 FDS Closure Program meeting between the Presidio Trust, the Regional Water Quality Control Board ("Water Board"), the Department of Toxic Substances Control ("DTSC"), and the National Park Service ("NPS"). At the time, stakeholders agreed that FDS Section MT-14 would be evaluated in conjunction with former underground storage tanks ("USTs") 334, 335.1, 335.2, 336, 337, 338.1, 338.2, 339, 340, 341, 342, 343, 344.1, 344.2, 345.1, and 345.2 located along Infantry Terrace and Sibert Loop ("Infantry Terrace (FDS Section MT-14) Area" or "Site").

Additional soil sampling and groundwater monitoring well installation proposed at the Infantry Terrace (FDS Section MT-14) Area is in keeping with the decision logic developed for data gap analysis at former FDS Sections as discussed in the FSP (EKI, 2007) and as presented in Table 1, with modifications as discussed in Section 2.0. A total of 28 soil samples are proposed at 21 sampling locations at the Infantry Terrace (FDS Section MT-14) Area to address data gaps in the FDS Removal Program (IT, 1999b) and the Indoor Tanks Removal Project (MW, 1998b). Additionally, four new groundwater monitoring wells are proposed at the Infantry Terrace (FDS Section MT-14) Area for monitoring of potential groundwater impacts from petroleum hydrocarbons. No groundwater sampling is included in this FSP because monitoring of groundwater at the proposed wells will be included as part of the Trust's Presidio-wide quarterly groundwater monitoring program

[1] Acronyms and abbreviations used throughout this FSP Addendum are listed in Appendix A.

1.0 BACKGROUND

The Infantry Terrace (FDS Section MT-14) Area is located in the central portion of the Presidio, as shown on the Index Map included with the attached figures. The Infantry Terrace (FDS Section MT-14) Area contains a loop of single-family residential houses and duplexes located along Sibert Loop. They were occupied by officers and their families from circa 1900 until 1988, while the Presidio was operated as an Army base. The houses are currently rented out by the Presidio Trust.

Fuel oil was supplied to the houses by a gravity-fed FDS pipeline which conveyed fuel oil from the main storage tank, Aboveground Storage Tank ("AST") 1349, located in the western portion of the Presidio. The portion of FDS pipeline within the Site boundary has been identified as MT-14, according to the designation given by the Army as part of the FDS removal program (see Figure 1). Fuel oil was stored in the basement of each house or unit, generally in a 190 gallon UST (MW, 1998a). Fuel oil was used to heat the houses until the early 1960s, when fuel oil was replaced with natural gas.

1.1 <u>FDS Removal</u>

Between 1996 and 1999, the majority of FDS pipeline was removed throughout the Presidio, including the Infantry Terrace (FDS Section MT-14) Area, as part of the FDS removal program conducted by the U.S. Army Corps of Engineers ("Army") (IT, 1999b). FDS removal was completed according to the work plan entitled, *Work Plan, Removal/Abandonment of FDS and Buildings 970/971* ("Work Plan") (IT, 1996). Soil sampling frequency and laboratory analytical results for soil samples collected along FDS Section MT-14 are summarized in Table 2.

1.1.1 Overexcavation No. 7

Due to the presence of visibly stained and odorous soil encountered along the FDS pipeline during removal, an overexcavation was conducted in the vicinity of Buildings 340 and 341 ("Overexcavation No. 7") (see Figure 1). Approximately 1,667 cubic yards of soil was removed during overexcavation activities (IT, 1999b). Further excavation was limited in lateral extent to be within 5 feet of Buildings 340 and 341 to protect the structural integrity of the buildings' foundations and the vertical extent of the overexcavation was limited by the presence of bedrock. Twenty-six confirmation soil samples were collected from the bottom and sidewalls of Overexcavation No. 7. The results of five soil samples were above applicable cleanup levels in the vicinity of Building 340 and 341, as shown on Figure 2. No stained or odorous soil was encountered in the test pit dug immediately east of the overexcavation.

1.1.2 Building 340 Basement Waterproofing

As part of restoration activities conducted along FDS Section MT-14 after FDS removal (IT, 1996), an excavation approximately 45 ft long, 8 feet wide, and 6 feet deep was conducted along the eastern wall of Building 340 and a waterproofing membrane was applied to the exterior wall surface (IT, 1999a). Additionally, a 4-inch diameter slotted PVC pipe was installed at the base of the wall to facilitate runoff from the basement wall composite drainage system. As shown on Figure 2, additional excavation activities likely removed a portion of the soil found to be above applicable cleanup levels along the eastern wall of Building 340, including soil in the vicinity of Army sample FM14098W12(5.5).

1.2 UST Removal

USTs in the Infantry Terrace (FDS Section MT-14) Area were removed in 1997. During removal, the USTs were visually inspected for signs of leakage, including corrosion and holes on the UST walls and along associated piping, and stained soil or the presence of free product directly beneath the UST. If the soil was observed to be visibly impacted, the affected soil was overexacavated until no visual staining was observed or until the limits of the overexcavation were achieved, such as the top of the bedrock or the building foundation. Generally, two confirmation soil samples were collected beneath the UST and one confirmation soil sample was collected from beneath the associated piping after removal.

1.2.1 UST Notices of Completion

UST removal was conducted under the oversight of the San Francisco Department of Public Health ("SFDPH"). Upon completion of UST removal activities, a Notice of Completion ("NOC") was issued by the SFDPH for all USTs removed at the Infantry Terrace (MT-14) Area as well as USTs located throughout the Presidio. In cases where NOCs indicated that no additional remedial work was recommended, the Trust considers the SFDPH NOCs to be case closure letters for the USTs. USTs considered by the Trust to be closed through SFDPH NOCs include the following:

- 335.1,
- 335.2,
- 341,
- 344.1,
- 344.2,

- 345.1, and
- 345.2.

NOCs for the aforementioned USTs are included in Appendix B.

In cases where corrosion holes, staining, or other signs of release were noted during UST removal, the completion of an unauthorized release report was required and UST closure was referred to the SFDPH Local Oversight Program ("LOP") for further review. In cases where the NOC letter required additional soil or groundwater investigation in the vicinity of the UST, the case was referred to the Water Board for further review. Neither EKI nor the Trust is aware of any additional information regarding SFDPH LOP documentation for USTs at the Infantry Terrace (FDS Section MT-14) Area.

1.2.2 Mini-Corrective Action Plans

In 1998, the Army intended to close all USTs at the Infantry Terrace (FDS Section MT-14) Area through the Presidio Mini-Corrective Action Plan ("Mini-CAP") program,[2] including USTs which the Trust considers to be closed through NOCs. To that effect, UST removal documentation reports prepared by the Army in 1998 stated that a Mini-CAP would be submitted to the RWQCB for review and approval for all USTs in the Infantry Terrace (FDS Section MT-14) Area (MW, 1998a).

As part of the Petroleum Site Cleanup Program (Round 2 Group 1 Tanks), the Army prepared Mini-CAPs for several USTs in the Infantry Terrace (FDS Section MT-14) Area where no further action was recommended (MW, 1998b), including:

- UST 337,
- UST 338.2, and
- UST 341.[3]

Mini-Corrective Action Plans for these USTs are included as Appendix C. Neither the Trust nor EKI is aware of any case closure letters issued by the Water Board in response to the Army's request for no further action at these three USTs.

USTs in the Infantry Terrace (FDS Section MT-14) Area which were not considered closed through a SFDPH NOC or Mini-CAP prepared by the Army, were identified as Mini-CAP Sites in Water Board Order R2-2003-0080, including:

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[2] Mini-CAP sites refer to petroleum release sites where no contamination other than fuel products have been released and where groundwater quality has not been impacted (Water Board Order No. R2-2003-0080).
[3] UST 341 is also considered to be closed by the Trust through an SFDPH NOC.

- UST 334,
- UST 338.1,
- UST 339,
- UST 342, and
- UST 343.

At the Trust's request, additional soil and groundwater sampling at these Mini-CAP sites and along FDS Section MT-14 was conducted by Geo/Resources Consultants, Inc. ("GRC") in 2005 (GRC, 2006). Soil and groundwater sample results from the 2005 field investigation are summarized on Figures 1 and 2.

2.0 DATA GAP ANALYSIS

Table 1 outlines the decision logic used to evaluate the effectiveness of the Army's FDS Removal Program. The general decision logic for Levels I and III Decision Criteria developed for assessing data gaps at individual FDS sections are applicable to assess data gaps at individual USTs in the Infantry Terrace (FDS Section MT-14) Area, unless the USTs were closed by the SFDPH, as discussed below. Level II Decision Criteria do not apply to any UST Sites.

USTs closed under the jurisdiction of the SFDPH[4] are not subject to sampling according to the FDS FSP decision logic and therefore no additional soil samples are proposed at these USTs. However, closed USTs where soil was found to be above residential cleanup levels based on laboratory analytical results, or potentially above residential cleanup levels based on immunoassay results, will be included in a Land Use Control ("LUC") for the Infantry Terrace (FDS Section MT-14) Area.

The general Decision Criteria for determination of additional work to be conducted along FDS MT-14 and at former USTs in the Infantry Terrace (FDS Section MT-14) Area are summarized in Table 1. An evaluation of data gaps along FDS Section MT-14 and at the former UST locations in the Infantry Terrace (FDS Section MT-14) Area are summarized in Table 2.

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[4] As discussed in Section 1.2.1, USTs issued an NOC which stated that no further action was necessary at the UST location are considered by the Trust to be closed.

3.0 FIELD INVESTIGATION

3.1 Pre-Field Activities

A pre-field work site walk will be conducted by the Trust (and any other stakeholder that wishes to attend) to confirm the planned sampling locations, mark agreed-upon sample locations for Underground Service Alert ("USA") and Trust locating services, and discuss potential issues associated with utilities, traffic, access, tenants, native plants, special habitats, historic structures, and any other Site-specific issues.

Similar to other Trust projects, activities associated with utility clearance (including utility locating), permitting or other regulatory requirements, and coordinating for the Presidio-specific Trust reviews and compliance activities (e.g., N^2) will be performed and coordinated by the Trust. EKI will notify USA of planned sampling events after sample locations have been marked in the field.

3.2 Sample Naming Conventions

In accordance with the Presidio-wide Quality Assurance Project Plan ("QAPP"), sample location identification codes are based on "MT-14," "334," "337," "338.1," "339," and "342" for FDS Section MT-14, UST 334, UST 337, UST 338.1, UST 339, and UST 342, respectively; "SB" for soil boring; and "MW" for monitoring well. Additionally, the proposed well in the vicinity of Overexcavation No. 7 is named with the prefix "FM14" in accordance with previous groundwater monitoring well naming convention used at wells in the vicinity of Overexcavation No. 7. Multiple samples could be collected from a single soil boring sample location. In keeping with the previous soil sampling designation, all soil samples collected in the basement of buildings will be measured in feet below the basement floor ("ft bbf"). All other samples will be collected in feet below ground surface ("ft bgs"). In keeping with the QAPP, a soil sample from Building 342 at 2 ft bbf or 2 ft bgs will be designated as 342SB101[2].

3.3 General Field Procedures for Collection of Soil Samples

EKI plans to collect 15 soil samples along FDS Section MT-14 and 13 soil samples at former UST locations. Soil samples will be collected in accordance with field methods and procedures outlined in the FSP (EKI, 2007). Soil samples will be collected using either a hand auger or a direct push drill rig, generally from 0 to 11 ft bgs.

3.4 General Field Procedures for Installation of Monitoring Wells

EKI plans to install four (4) groundwater monitoring wells. The monitoring wells are intended to be approximately 30 ft downgradient of the USTs or excavation areas (see Table 4), assuming groundwater follows the topographic contours. Monitoring wells will be installed in accordance with the field methods and procedures as specified in the Standard Operating Procedures ("SOP") 4 (included as Appendix D) and SOP 001, SOP 009, and SOP 014 included in the FSP (EKI, 2007).

The proposed monitoring wells will be screened within the shallow groundwater zone. Based on the existing wells in the Infantry Terrace (FDS Section MT-14) Area, EKI anticipates that the groundwater monitoring wells will be completed to a depth of approximately 46 ft bgs and will be screened over a 20-foot depth interval, i.e., from approximately 25 ft bgs to 45 ft bgs. An EKI field geologist will determine the final depth of each well and the well screen interval before the well is constructed. The monitoring wells will be constructed of 2-inch ID Schedule 40 PVC, blank and factory-slotted (0.010-inch) casing with flush-threaded couplings.

The well casings will be set through the 8-inch outside diameter ("OD") hollow-stem augers. No solvents or cements will be used during construction of the well-casing. After each PVC casing has been installed, No. 2/16 Lapis Lustre sand will be slowly poured down the annular space between the augers and the well casing for sand pack placement if less than five-feet of groundwater present within the borehole at the time of well construction. If more than five feet of groundwater is present within the borehole, sand will be placed into the annular space of the well using a tremie pipe. The augers will be pulled out of the ground a few feet at a time during sand placement. Sand will be added to the annular space to approximately 2 feet above the top of the screened interval and 2 to 3 feet of bentonite pellets will be placed on top of the sand and hydrated. The remaining portion of the annular space will be sealed with cement grout. The top of the well will be set in concrete in a watertight, traffic-rated vault box at grade and a locking PVC expansion plug will be used to seal the wellhead and provide security. After grouting and well box installation, the extraction wells will be allowed to sit undisturbed for a minimum of 48 hours before well development.

3.5 General Field Procedures for Monitoring Well Development

Monitoring wells will be developed by Blaine Tech Services, Inc. ("BTS") of San Jose, California, in general accordance with SOP 005, included in Appendix D of this FSP Addendum.

3.6 General Field Procedures for Surveying

PLS Surveys Inc. of Oakland, California will survey the soil sample and monitoring well locations to GeoTracker specifications, in general accordance with SOP 013, which is included in Appendix C of the FSP. The horizontal coordinates will be reported in NAD 83. The vertical coordinates will be reported in both the North American Vertical Datum 88 ("NAVD 88") as well as the 1907 Presidio Lower Low Water ("PLLW") vertical datum. Local benchmarks will be provided by the Trust.

3.7 Field Quality Control Samples

Field duplicates will be collected as part of this investigation. A field duplicate is a sample collected at the same time and from the same source and depth as the associated primary sample. Field duplicate pairs are collected to assess the consistency or precision of the laboratory's analytical system. The QAPP specifies a frequency of 10% for field duplicates; therefore, 3 field duplicate soil samples are planned to be collected and submitted to the laboratory for analysis.

Additionally, 2 matrix spike / matrix spike duplicate ("MS/MSD") samples will be collected and submitted to the laboratory for analysis according to the QAPP, which specifies a frequency of 5% for MS/MSD samples. MS/MSD samples are collected to assess the effects of the sample matrix on the lab analytical results.

3.8 Analytical Methods

Analytical methods proposed for soil samples include the following:

- TPH as diesel ("TPHd") and TPHfo[5] with silica gel cleanup by EPA Method 8015M.[6]
- Polycyclic aromatic hydrocarbons ("PAHs") by EPA Method 8270C

The analytical quality control criteria are provided in the QAPP. The laboratory will provide U.S. EPA Level III data report packages, including a narrative explanation of any discrepancies from the standard analytical methods, as identified in the QAPP. To comply with the QAPP, at least ten percent of the data will be reported in Level IV format to meet data validation requirements. Analytical data will be validated by DataVal, Inc.

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[5] Carbon range quantified for TPHfo is C24 to C36, which is the same as a typical motor oil range.
[6] The reporting carbon ranges for TPHd and TPHfo are C12 to C24 and C24 to C36, respectively.

4.0 SCHEDULE

Field work will commence upon stakeholder approval of the FSP Addendum and coordination with the Trust, the drilling contractor, and field staff. It is anticipated that the soil sampling and monitoring well installation activities included in the FSP Addendum will be conducted in conjunction with the FSP field investigation, if possible. It is expected that soil sampling and monitoring well installation at the Infantry Terrace (FDS Section MT-14) Area can be completed in four days, assuming one field crew conducts soil sampling and another field crew installs the groundwater monitoring wells. It is expected that well development of the four proposed monitoring wells can be completed in two days, with well development to be started at least 48 hours after well installation.

A report of findings from the MT-14 (FDS Section MT-14) Area as well as the results from first round of the groundwater sampling from the four proposed wells will be included in the report of results from the 29 additional FDS Sections included in the FDS FSP.

Please do not hesitate to contact us at (650) 292-9100 if you have any questions or comments.

Very truly yours,
ERLER & KALINOWSKI, INC.

REGISTERED GEOLOGIST
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Tables

Table 1 - General Decision Criteria for Determination of Additional Work to be Conducted at Individual Fuel Distribution System Sections and at Former UST Locations

Table 2 -Evaluation of Data Gaps at Fuel Distribution System Section MT-14 and Underground Storage Tanks at the Infantry Terrace (FDS Section MT-14) Area

Table 3 - Soil Sample Laboratory Analysis Matrix for Data Gap Analysis at the Infantry Terrace (FDS Section MT-14) Area

Table 4 - Groundwater Sample Laboratory Analysis Matrix for Data Gap Analysis at the Infantry Terrace (FDS Section MT-14) Area

Figures

From IT, 1999b - Index Map, from FDS Removal Program Removal Report
Figure 1 - Historical Soil Sampling Data and Proposed Sampling Locations at the Infantry Terrace (FDS Section MT-14) Area
Figure 2 - Historical Soil Sampling Results at Overexcavation No. 7

Appendices

Appendix A - Acronyms and Abbreviations
Appendix B – SFDPH Notices of Completion
Appendix C – Mini-Corrective Action Plans for USTs 337, 338.2, and 341
Appendix D – SOPs 4 and 5

References

EKI, 2007. *Field Sampling Plan – Former Fuel Distribution System Closure Phases II and III, Presidio of San Francisco, California.* April.

Geo/Resource Consultants, Inc. ("GRC"), 2007. *Mini-CAP Additional Investigations, Excavation, and Groundwater Monitoring Well Installations to Address Former Petroleum Release Site, UST Removal Program, Presidio of San Francisco, California.* August.

International Technology Corporation ("IT"), 1996. *Work Plan, Removal/Abandonment of Fuel Distribution System and Buildings 970/971, Presidio of San Francisco, CA.* May.

IT, 1999a. *Fuel Distribution System (FDS), Basement Waterproofing As-Built, Building 340, Presidio of San Francisco.* February.

IT, 1999b. *Fuel Distribution System Closure Report, Presidio of San Francisco, California.* May.

Montgomery Watson ("MW"), 1998a. *Removal of Storage Tanks Inside Historical Buildings Project Report, Presidio of San Francisco, California.* January.

MW, 1998b. *Final Round 2, Group 1 Mini-Corrective Action Plans, Petroleum Sites Cleanup Program, Presidio of San Francisco, California.* August.

Treadwell & Rollo, Inc. ("T&R"), 2007. *Semi-Annual Groundwater Monitoring Report, Third and Fourth Quarters 2006, Presidio-Wide Quarterly Monitoring Program, Presidio of San Francisco (Volumes I and II).* April.

Table 1
General Decision Criteria for Determination of Additional Work to be Conducted at Individual Fuel Distribution System Sections and at Former UST Locations
Presidio of San Francisco, California

Level I Decision Criteria

If:

* Chemical concentrations in confirmation soil samples are above applicable cleanup levels (i.e., TPH, PAHs, or BTEX), [a]
* Chemical concentrations in stockpile soil samples are above applicable cleanup levels for TPH, PAHs, or for BTEX and such stockpiled soil was used as backfill; and/or
* Chemical concentrations in LTTD treated soil are potentially above applicable cleanup levels and such LTTD-treated soil was used to backfill trenches or excavations,

Then:

* Collect soil samples or confirmation soil samples to assess horizontal and vertical extent of affected soil.

Else:

* Go to Level II Criteria.

Level II Decision Criteria [b]

If:

* Removed pipeline confirmation soil sampling frequency was greater than 100 lf/sample;
* Abandoned pipeline sampling frequency was greater than 50 lf/sample;
* Overexcavation confirmation soil sampling frequency was greater than 7.5 lf/sample;
* Confirmation soil samples were not collected at each overexcavation;
* Stockpile soil sampling frequency was greater than 50 cy/sample where soil was used as backfill [c];
* Abandoned lengths of pipe greater than 20 lf were not pressure tested; and/or
* Abandoned piping failed pressure testing criterion.

Then:

* Collect confirmation soil samples as appropriate to address data gaps. The need for sampling is often dictated by the presence of visually contaminated soil or the performance of overexcavation along the FDS section.

Else:

* Go to Level III Criteria.

If:

* Potential groundwater impacts may exist (e.g., high chemical concentrations at depths greater than 10 ft bgs where groundwater may be relatively shallow).

Then:

* Evaluate chemical concentrations as a function of depth at sample location where petroleum hydrocarbons could potentially impact groundwater.

Table 1
General Decision Criteria for Determination of Additional Work to be Conducted at Individual Fuel Distribution System Sections and at Former UST Locations
Presidio of San Francisco, California

Abbreviations:
BTEX - Benzene, toluene, ethylbenzene, xylenes
cy - cubic yards
FDS - Fuel Distribution System
ft bgs - feet below ground surface
ft - feet
lf - linear feet
LTTD - Low-Temperature Thermal Desorption
PAHs - Polycyclic Aromatic Hydrocarbons
RWQCB - Regional Water Quality Control Board
TPH - Total Petroleum Hydrocarbons
TPHd - Total Petroleum Hydrocarbons quantified as diesel
TPHfo - Total Petroleum Hydrocarbons quantified as fuel oil
UST - Underground Storage Tank

Notes:

(a) Applicable cleanup levels used by the Army were obtained from former RWQCB Order 96-070. The same cleanup levels were incorporated into the current Order for the Presidio, RWQCB Order R2-2003-0080. The current Order also includes cleanup levels for petroleum hydrocarbons and related constituents for sites within the saltwater and freshwater ecological protection zones. Application of the freshwater ecological protection zone values is described in the document prepared by BBL, entitled "Draft Development of Freshwater TPHd and TPHfo Point of Compliance Concentrations, Presidio of San Francisco, California" and dated 15 July 2005.
(b) Level II Decision Criteria originate from the testing and sampling requirements included in former RWQCB Order 96-070.
(c) Stockpiled soil potentially used as backfill was overburden soil from the removal of FDS piping. If chemical concentrations in stockpiled soil were greater than applicable cleanup levels, stockpiled soil was supposed to be either treated at the LTTD unit or disposed off-site.
(d) USTs closed through the San Francisco Department of Public Health Notices of Completion are not subject to the FDS decision criteria.

Table 2
Evaluation of Data Gaps at Fuel Distribution System Section MT-14 and Underground Storage Tanks at the Infantry Terrace (FDS Section MT-14) Area
Presidio of San Francisco, California

FDS Closure Phase Number	UST or FDS Section	Area (A/B)	Previous Recommendation (1)	Trust Recommendation	Level I (2)				Level II (3)							Level III (4)	Remarks	Trust Recommendations for Proposed Future Work (12)	# Samples Analyzed for TPH (EPA 8015m)	# Samples Analyzed for PAHs (EPA 8270C)	# Samples Analyzed for BTEX (EPA 8260B)	# Groundwater wells
					CSS Potentially > CL for individual TPH?	CSS Potentially > CL for individual PAHs?	Stockpile CSS Potentially > CL used as Backfill?	LTTD Potentially in Soil > CL?	Removed Pipeline CSS Frequency > 100 ft/sample? (5)	Abandoned Pipeline Sampling Frequency >50 ft/sample? (6)	Overexcavation Sampling Frequency >7.5 ft/sample? (7)	SS at Each Overexcavation?	Stockpile Sampling Frequency > 50 cy/sample or none? (8)	Adequate Pressure Testing? (9)	Pressure Test Failure? (10)	Potential Groundwater Impacts? (11)						
TBD	FDS MT-14	B	CAP, Mini-CAP, CSS	CSS, SS, GW	yes	yes	yes	no	26	40	3.7	no	30	no	yes	yes	(1) Although the overall overexcavation sampling frequency for FDS Section MT-14 was adequate, only one confirmation soil sample was collected for an excavation 30 feet in length near Building 334. (2) Stockpiled soil with PAH concentrations > CL was used as backfill (PAH = 6.8 mg/kg in stockpile samples FM14095S01 and FM14095S02). (3) One soil sample (FM14SB108) collected by GRC in 2005 had TPH concentrations <CLs at 6.5 ft bgs (TPHd = 89 mg/kg and TPHfo = 230 mg/kg), but no samples were collected directly beneath the historical FDS line, at 2.5-3 ft bgs, where the highest concentrations of TPH would be expected and the GRC borehole log showed elevated PID readings. (4) No soil sample was collected at the end of an abandoned lateral at Building 381. (5) Chemical concentrations in CSS representative of soil remaining in place were potentially >CLs for TPH and PAHs at location FM14094L02 (PAHs > 5.0 mg/kg and TPH > 575 mg/kg) and FM14097L01 (TPH < 3,551 mg/kg and PAHs > 5.0 mg/kg). Additional soil sampling by GRC in 2005 adjacent to FM14097L01 (sample FM14SB119 at at 1.5 and 3.5 ft bgs) were <CLs for TPH and FM14094L02. (6) No confirmation soil samples were collected at an overexcavation between Building 383 and Building 341. (7) Groundwater impacts from soil exceeding cleanup levels in the vicinity of Building 341 have not been adequately assessed. Soil sample FM14EX07SB101(17.5) had TPH = 3,000 mg/kg (as shown on Figure 2), and the vertical extent of TPH within 5 ft of the groundwater elevation has not been assessed. TPHg and MTBE were detected at concentrations below cleanup levels in groundwater samples collected from wells FM14EX07MW101 and FM14EX07MW102, at a maximum concentration of 9 µg/L and 3.3 µg/L, respectively, in the vicinity of Overexcavation No. 7 (T&R, 2007). Soil samples at Overexcavation No. 7 had TPH and PAHs in CSS >CL, near Building 340 and near Building 341, where soil was inaccessible for further excavation. Additional excavation work (45 ft long, 6 ft deep and 8 ft wide) was completed along the western side of the excavation as part of the basement waterproofing of Building 340, and a portion of the affected soil near Building 340 may have been removed (IT, 1999a).	(1) Collect three native CSS along the overexcavation west of Building 334 and analyze for TPH and PAHs. (2) Collect seven overburden CSS at 1.5 to 2 ft bgs along removed pipeline and analyze for PAHs. (3) Collect one native CSS at 2.5 ft bgs in the vicinity of GRC soil sample location FM14SB108 and analyze for TPH. (4) Collect one soil sample (MT-14SB07), at 2.5 ft bgs, at the end of the abandoned lateral and analyze for TPH and PAHs. (5) Assess vertical extent of affected soil at Army sample location FM14094L02 by collecting one native CSS at 2 ft bgs and one native SS at 7 ft bgs and analyze all for TPH and PAHs. (6) Collect one CSS at the base of the overexcavation, assumed to be approximately 3.5 ft bgs, between Building 341 and Building 383 and analyze for TPH and PAHs. (7) Install one groundwater monitoring well (FM14MW103) downgradient of soil at Overexcavation No. 7, to be included in the Presidio-wide groundwater montoring program.	8	14	0	1
TBD	UST 334	B	Mini-CAP	CSS	yes	no	no	no	--	--	--	--	--	--	--	no	UST 334 and associated piping were removed on 18 April 1996. Some small holes were observed on the tank and the associated piping appeared to be rusted, although no holes were observed on piping during removal. Three confirmation soil samples were collected in the vicinity of UST 334. Immunoassay results of soil sample 334EX02(3.0) were potentially above cleanup levels for TPH (TPH >1,380 mg/kg), but <CLs for TPH in sample 334EX03(5.0), two feet directly below sample 334EX02(3.0). Therefore, TPH-affected soil >CLs, if present, is likely to be limited in vertical extent. PAHs were below applicable cleanup levels for samples collected at UST 334. The excavation was backfilled with CLSM and completed with six inches of concrete to match the existing basement floor.	Collect one confirmation soil sample in the vicinity of soil sample 334EX02(3.0), at 6.8 ft bgs, and analyzed for TPH and PAHs.	1	1	0	0
TBD	UST 335.1	B	NFA	SS	yes	yes	no	no	--	--	--	--	--	--	--	no	UST 335.1 and associated piping were removed on 9 May 1996. The tank was corroded with numerous holes observed during removal. Visually stained soil was observed at the bottom of the final excavation. TPHfo was above applicable cleanup levels (TPHfo = 3,300 mg/kg) in sample 335.1EX01(0.5). Further excavation was limited by the underlying bedrock and by concerns of undermining the structural integrity of the building. The excavation was backfilled with CLSM and completed with six inches of concrete to match the existing basement floor.	Based on closure received through SFDPH NOC, no further work is proposed at the UST.	0	0	0	0

Table 2
Evaluation of Data Gaps at Fuel Distribution System Section MT-14 and Underground Storage Tanks at the Infantry Terrace (FDS Section MT-14) Area
Presidio of San Francisco, California

					Level I (2)				Level II (3)							Level III (4)						
FDS Closure Phase Number	UST or FDS Section	Area (A/B)	Previous Recommendation (1)	Trust Recommendation	CSS Potentially > CL for individual TPH?	CSS Potentially > CL for individual PAHs?	Stockpile CSS Potentially > CL used as Backfill?	LTTD Potentially in Soil > CL?	Removed Pipeline CSS Frequency > 100 ft/sample? (5)	Abandoned Pipeline Sampling Frequency >50 ft/sample? (6)	Overexcavation Sampling Frequency >7.5 ft/sample? (7)	SS at Each Overexcavation?	Stockpile Sampling Frequency > 50 cy/sample or none? (8)	Adequate Pressure Testing? (9)	Pressure Test Failure? (10)	Potential Groundwater Impacts? (11)	Remarks	Trust Recommendations for Proposed Future Work (12)	# Samples Analyzed for TPH (EPA 8015m)	# Samples Analyzed for PAHs (EPA 8270C)	# Samples Analyzed for BTEX (EPA 8260B)	# Groundwater wells
TBD	UST 335.2	B	NFA	NFA	no	no	no	no	--	--	--	--	--	--	--	no	UST 335.2 and associated piping were removed on 10 May 1996. During removal, two small holes were observed in the UST, but the associated piping was in sound condition. No stained soil was observed at the base of the excavation. Confirmation soil samples collected in the vicinity of the former UST were below applicable cleanup levels. The excavation was backfilled with CLSM and completed with 6 inches of concrete to match the existing basement floor.	Based on closure received through SFDPH NOC, no further work is proposed at the UST.	0	0	0	0
TBD	UST 336	B	NFA	NFA	yes	no	no	no	--	--	--	--	--	--	--	no	UST 336 and associated piping were removed on 2 May 1996. During removal, numerous corrosion holes were observed throughout the UST as well as the associated piping. Stained soil was observed at the base of the excavation. Three confirmation soil samples were collected in the vicinity of the UST 336 excavation. One confirmation soil sample collected at approximately 10 ft bgs was above applicable cleanup levels for TPH (TPHd = 2,000 mg/kg and TPHfo = 3,300 mg/kg in soil sample 336EX02(3.0)) for soil from 0 to 10 ft bgs, but below applicable cleanup levels for soil >10 ft bgs. Therefore, soil directly below this soil sample is below cleanup levels. Further excavation was limited by the presence of bedrock and from concerns about undermining the integrity of the building foundation. The excavation was backfilled with 3 inches of gravel and 2.25 ft of CLSM. The surface was completed with 6 inches of concrete to match the existing basement floor. Based on water levels measured at wells FM14EX07MW101 and FM14EX07MW102, the depth of groundwater is estimated to be approximately 23.90 to 30.04 ft bgs. Therefore, groundwate is unlikely to be affected by TPH in soil remaining in place.	Based on soil sampling results, no further work is proposed at the Site.	0	0	0	0
TBD	UST 337	B	NFA	CSS	yes	yes	no	no	--	--	--	--	--	--	--	no	UST 337 and associated piping were removed on 23 May 1996. The tank was corroded, but no holes were observed on the tank and associated piping was observed to be in sound condition during removal. Three confirmation soil samples were collected in the vicinity of UST 337, with two confirmation soil samples potentially above applicable cleanup levels for TPH or PAHs (TPH >1,380 mg/kg in soil samples 337EX02(3.0) and 337EX03(5.0)) (PAH > 5.52 mg/kg in soil sample 337EX03(5.0)) (MW, 1998). Further excavation was limited by the presence of bedrock and the potential for undermining the foundation of the building. The excavation was backfilled with 2.5 ft of CLSM and the surface was finished with 6 inches of concrete to match the existing basement floor.	Collect CSS at 8.5 and 10.5 ft bgs, in the vicinity of soil samples 337EX02(3.0) and 337EX03(5.0) and analyze for TPH and PAHs.	2	2	0	0
TBD	UST 338.1	B	Mini-CAP	SS, GW	yes	no	no	no	--	--	--	--	--	--	--	yes	UST 338.1 and associated piping were removed on 26 April 1996. The tank was corroded and numerous holes were observed throughout the tank, while the associated piping was observed to be corroded with no holes observed during removal. Soil was overexcavated to the bedrock surface, and further excavation would have potentially undermined the building foundation. The excavation was backfilled with 6 inches of gravel and 3 feet of CLSM. The surface was finished with 6 inches of concrete to match the existing basement floor. Several soil samples collected by the Army in 1999 and additional soil samples collected by GRC in 2005 were >CL for TPH. The lateral and vertical extent of TPH >CL is not defined to the south of the former UST location.	Collect six soil samples at three soil sampling locations (338.1SB105 through 338.1SB107) to the south of UST 338.1, at 8 and 11 ft bgs each, and analyzed for TPH. Install one groundwater monitoring well (338MW101) downgradient of UST 338.1 and include in the Presidio-wide groundwater monitoring program.	6	0	0	1
TBD	UST 338.2	B	NFA	NFA	no	no	no	no	--	--	--	--	--	--	--	no	UST 338.2 and associated piping were removed on 16 May 1996. One soil sample was collected beneath the associated lateral piping (338.2EX03(1.0)) and two soil samples (and one duplicate soil sample) were collected from beneath the UST (samples 338.2EX01(4.5) and 338.2EX02(3.0)) (MW,1998). Soil samples were <CLs for TPH and PAHs. The excavation was backfilled with CLSM and finished with 6 inches of concrete to match the existing basement floor.	Based on soil sampling results, no further work is proposed at the Site.	0	0	0	0

Table 2
Evaluation of Data Gaps at Fuel Distribution System Section MT-14 and Underground Storage Tanks at the Infantry Terrace (FDS Section MT-14) Area
Presidio of San Francisco, California

					Level I (2)				Level II (3)							Level III (4)					
FDS Closure Phase Number	UST or FDS Section	Area (A/B)	Previous Recommendation (1)	Trust Recommendation	CSS Potentially > CL for individual TPH?	CSS Potentially > CL for individual PAHs?	Stockpile CSS Potentially > CL used as Backfill?	LTTD Potentially in Soil > CL?	Removed Pipeline CSS Frequency > 100 ft/sample? (5)	Abandoned Pipeline Sampling Frequency >50 ft/sample? (6)	Overexcavation Sampling Frequency >7.5 ft/sample? (7)	SS at Each Overexcavation?	Stockpile Sampling Frequency > 50 cy/sample or none? (8)	Adequate Pressure Testing? (9)	Pressure Test Failure? (10)	Potential Groundwater Impacts? (11)	Remarks	Trust Recommendations for Proposed Future Work (12)	# Samples Analyzed for TPH (EPA 8015m)	# Samples Analyzed for PAHs (EPA 8270C)	# Samples Analyzed for BTEX (EPA 8260B)	# Groundwater wells
TBD	UST 339	B	Mini-CAP	SS	yes	no	no	no	--	--	--	--	--	--	--	yes	UST 339 and associated piping were removed on 22 May 1999. The tank had numerous corrosion holes, but the associated piping was in sound condition during removal. Stained soil at the bottom of the excavation was overexcavated, and six confirmation soil samples were collected from the bottom of the overexcavation. Two confirmation soil samples exceeded cleanup levels for TPHd with a maximum concentration of 1,900 mg/kg in sample 339EX05(1.5). Two soil samples potentially exceed applicable cleanup levels (TPH > 1,380 mg/kg in soil samples 339EX01(4.0) (and its duplicate sample) and 339EX02(3.5)). Additionally, soil sample 339EX01 potentially exceeds applicable cleanup levels for PAHs (PAH > 5.52 mg/kg). One foot of gravel and 2 feet of CLSM were used to backfill the excavation. The surface was finished with 6 inches of concrete to match the existing basement floor. In 2005, GRC conducted an additional soil investigation in the vicinity of former UST 339. Based on the GRC data, the lateral extent of TPH > CLs was larger than previously identified. The lateral and vertical extent of TPH >CLs in the vicinity of UST 339 has not been characterized. The Site is inaccessible for further excavation of soil >CLs, due to the presence of bedrock and the potential to undermine the building foundation.	Collect two soil samples in yard on the eastern side of Building 339 at 8 and 11 ft bgs, in the vicinity of former UST 339, and analyze for TPH. Install one groundwater monitoring well (339MW101) downgradient of former UST 339, to be included in the Presidio-wide groundwater montoring program.	2	0	0	1
TBD	UST 340	B	NFA	NFA	yes	no	no	no	--	--	--	--	--	--	--	no	UST 340 and associated piping were removed on 26 April 1996. During removal, the UST was observed to be extremely corroded, with numerous small holes. The associated piping was observed to be in sound condition. Free product was observed on the eastern and western sidewalls of the excavation, extending from two feet below the basement floor to the bottom of the excavation. The free product may have been caused by leaking FDS piping outside the building. Four confirmation soil samples were collected in the vicinity of excavation of UST 340. Three of the four confirmation soil samples were >CLs for TPH, with a maximum reported concentration of TPHd = 3,700 mg/kg and TPHfo = 3,800 mg/kg in soil sample 340EX04(4.0). The excavation was backfilled with 1 foot of gravel and 1.5 feet of CLSM. The surface was finished with 6 inches of concrete to match the existing basement floor. Although multiple problematic samples exist at the Site, the lateral and vertical extent of the affected soil has been determined and further excavation is not accesible. An existing groundwater monitoring well (FM14EX07MW102) is located downgradient of Building 340.	Based on soil sampling results, no further work is proposed at the Site.	0	0	0	0
TBD	UST 341	B	NFA	CSS	yes	no	no	no	--	--	--	--	--	--	--	no	UST 341 and associated piping were removed on 30 May 1996. Several corrosion holes were observed in the tank during excavation. Soil staining was observed in the floor of the excavation and was overexcavated. Two soil samples were collected from beneath the UST (samples 341EX01(4.0) and 341EX02(3.0)) (MW, 1998). Immunoassay results for sample 341EX02 (TPH > 1,380 mg/kg) may potentially exceed cleanup levels. The excavation was backfilled with CLSM and the surface was finished with 6 inches of concrete to match the existing basement floor.	Based on closure received through SFDPH NOC, no further work is proposed at the UST.	0	0	0	0
TBD	UST 342	B	Mini-CAP	SS, GW	yes	no	no	no	--	--	--	--	--	--	--	yes	UST 342 and associated piping were removed on 28 June 1996. Soil beneath the UST was stained and soil samples exceeded soil cleanup levels. Additional soil sampling by GRC in 2005, at three sampling locations, confirmed that soil in the vicinity of former UST 342 was above applicable cleanup levels. However, the horizontal and vertical extent of TPH affected soil was not defined through the additional sampling. Additional excavation of affected soil is limited by the presence of bedrock and may undermine the foundation of Building 342. Components of an in-situ remediation system, consisting of perforated PVC piping within a 3 foot layer of gravel, were placed at the bottom of the excavation. The gravel was covered with 1.5 feet of CLSM and the surface was finished with 6 inches of concrete to match the existing basement floor.	Collect two SS at proposed sample location 342SB107 in the yard to the east of the former UST, at 8 and 11 ft bgs, and analyze for TPH. Install one groundwater monitoring well (342MW101) downgradient of former UST 342 and included in the Presidio-wide groundwater monitoring program.	2	0	0	1
TBD	UST 343	B	Mini-CAP	SS	yes	no	no	no	--	--	--	--	--	--	--	no	UST 343 and associated piping were removed on 16 May 1996. Several corrosion holes were observed in the tank during excavation. Stained soil was observed in the floor of the excavation and was removed. Three confirmation soil samples were collected in the vicinity of UST 343. One confirmation soil sample (343EX02(3.0)) was potentially above applicable cleanup levels for TPH (TPH > 1,380 mg/kg) and PAHs (PAH > 5.52 mg/kg). One confirmation soil sample (343EX03(4.0)) was above applicable cleanup levels for TPHd (TPHd = 1,700 mg/kg), but below applicable cleanup levels for TPHfo (TPHfo = 1,700 mg/kg). Additional sampling by GRC in 2005 showed that TPH in the vicinity of UST 343 appears to be limited and that PAHs appear to be <CLs. Further excavation is limited by the presence of bedrock and may compromise the structural integrity of Building 343. The excavation was backfilled with CLSM and the surface was finished with 6 inches of concrete to match the existing basement floor.	Based on soil sampling results, no further work is proposed at the Site.	0	0	0	0

Table 2
Evaluation of Data Gaps at Fuel Distribution System Section MT-14 and Underground Storage Tanks at the Infantry Terrace (FDS Section MT-14) Area
Presidio of San Francisco, California

					Level I (2)				Level II (3)							Level III (4)						
FDS Closure Phase Number	UST or FDS Section	Area (A/B)	Previous Recommendation (1)	Trust Recommendation	CSS Potentially > CL for individual TPH?	CSS Potentially > CL for individual PAHs?	Stockpile CSS Potentially > CL used as Backfill?	LTTD Potentially in Soil > CL?	Removed Pipeline CSS Frequency > 100 ft/sample? (5)	Abandoned Pipeline Sampling Frequency >50 ft/sample? (6)	Overexcavation Sampling Frequency >7.5 ft/sample? (7)	SS at Each Overexcavation?	Stockpile Sampling Frequency > 50 cy/sample or none? (8)	Adequate Pressure Testing? (9)	Pressure Test Failure? (10)	Potential Groundwater Impacts? (11)	Remarks	Trust Recommendations for Proposed Future Work (12)	# Samples Analyzed for TPH (EPA 8015m)	# Samples Analyzed for PAHs (EPA 8270C)	# Samples Analyzed for BTEX (EPA 8260B)	# Groundwater wells
TBD	UST 344.1	B	NFA	NFA	no	no	no	no	--	--	--	--	--	--	--	no	UST 344.1 and associated piping were removed on 31 May 1996. Several corrosion holes were observed in the tank during excavation. Stained soil observed beneath the tank was overexcavated. Three confirmation soil samples collected in the vicinity of UST 344.1 were <CLs for TPH and PAHs. The excavation was backfilled with CLSM and finished with 6 inches of concrete to match the existing basement floor.	Based on closure received through SFDPH NOC, no further work is proposed at the UST.	0	0	0	0
TBD	UST 344.2	B	NFA	NFA	no	no	no	no	--	--	--	--	--	--	--	no	UST 344.2 and associated piping were removed on 14 June 1996. No holes were observed on the tank and stained soil observed beneath the tank was removed by overexcavation. Two confirmation soil samples collected in the vicinity of UST 344.2 were <CLs for TPH and PAHs. The excavation was backfilled with CLSM and finished with 6 inches of concrete to match the existing basement floor.	Based on closure received through SFDPH NOC, no further work is proposed at the UST.	0	0	0	0
TBD	UST 345.1	B	NFA	NFA	no	no	no	no	--	--	--	--	--	--	--	no	UST 345.1 and associated piping were removed on 21 June 1996. Several small holes were observed on the tank and the associated piping during removal. Three confirmation soil samples collected in the vicinity of UST 345.1 were <CLs for TPH and PAHs. The excavation was backfilled with CLSM and finished with 6 inches of concrete to match the existing basement floor.	Based on closure received through SFDPH NOC, no further work is proposed at the UST.	0	0	0	0
TBD	UST 345.2	B	NFA	NFA	no	no	no	no	--	--	--	--	--	--	--	no	UST 345.2 and associated piping were removed on 21 June 1996. Several corrosion holes were observed on the tank, but the associated piping was in sound condition during removal. Three confirmation soil samples collected in the vicinity of UST 345.2 were <CLs for TPH and PAHs. The excavation was backfilled with CLSM and finished with 6 inches of concrete to match the existing basement floor.	Based on closure received through SFDPH NOC, no further work is proposed at the UST.	0	0	0	0

Abbreviations:
Army - U.S. Army Corps of Engineers
bbf - below basement floor
BTEX - benzene, toluene, ethylbenzene, xylenes
CLSM - Controlled Low Strength Material
CSS - Confirmation Soil Sample
EKI - Erler & Kalinowski, Inc.
FDS - fuel distribution system
ft - feet
GRC - GeoResources Consultants, Inc.
GW - groundwater sample
IT - International Technology Corporation
lf - linear feet
LTTD - low temperature thermal desorption
MW - Montgomery Watson
NA - not applicable
NFA - no further action
NOC - Notice of Completion
PAH- Polycyclic aromatic hydrocarbons analyzed using immunoassay analysis
PAHs- Polycyclic aromatic hydrocarbons analyzed using laboratory analysis
SFDPH - San Francisco Department of Public Health
SS - soil sample
TBD - closure request phase is to be determined after implementation of FSP Addendum
TPH - total petroleum hydrocarbons analyzed using immunoassay analysis
TPHd - total petroleum hydrocarbons as diesel analyzed using laboratory analysis
TPHfo - total petroleum hydrocarbons as fuel oil analyzed using laboratory analysis

Notes:
(1) Previous recommendations are based the "Site Status" listed on the Army's Tank Table ("Presidio Site Management Schedule"), dated June 1999.
(2) Additional soil sampling is required for all FDS sections which fail any portion of Level I Decision Criteria (except at FDS sections where additional sampling was performed as part of a CAP or Mini-CAP). Applicable cleanup levels for each FDS Section are included in Appendix D of the FDS FSP.
(3) Additional soil sampling may be required for FDS sections which fail any portion of Level II Decision Criteria.
(4) An assessment of soil concentration as a function of depth or groundwater sampling is required for FDS sections which fail Level III Decision Criteria, and where additional sampling is not being conducted as part of a CAP or Mini-CAP.
(5) Former Water Board Order 96-070 required a sampling frequency of 100 lf/sample of pipeline removed, including one confirmation soil sample at each end of the removed length of pipeline, one confirmation soil sample at each change in pipeline direction, and one confirmation soil sample at each intersection of the FDS pipeline with lateral piping. CSS collected at a sampling frequency > 100 lf/sample for lengths of removed pipeline are highlighted in gray.
(6) Former Water Board Order 96-070 required a sampling frequency of 50 lf/sample for lengths of accessible abandoned piping. If the piping was inaccessible for sampling, the Army generally collected samples at both ends of abandoned piping. CSS collected at a sampling frequency > 50 lf/sample are highlighted in gray.

Table 2

Evaluation of Data Gaps at Fuel Distribution System Section MT-14 and Underground Storage Tanks at the Infantry Terrace (FDS Section MT-14) Area

Presidio of San Francisco, California

Notes (continued):

(7) The Army planned to sample overexcavation lengths at a frequency of 7.5 lf/sample. Highlighted fields indicate a sampling frequency of > 7.5 lf/sample.

(8) The Army recommended confirmation soil sampling for stockpiled soil at a frequency of 50 cy/sample. FDS sections where stockpiled soil was not sampled are indicated as "none". FDS sections where > 50 cy of stockpiled soil were generated and no samples were collected or FDS sections where the sampling frequency of stockpiled soil was > 50 cy/sample are highlighted in gray. Additionally, FDS sections where no soil samples were collected and < 50 cy of stockpiled soil were generated, but visually stained soil was found at the along the FDS section (as indicated by the presence of overexcavations) are highlighted in gray.

(9) Prior to November 1996, the Army performed pressure testing on lengths of abandoned pipeline > 50 lf and collected confirmation soil samples at a frequency of 50 lf/sample of abandoned piping. Subsequently, this provision was amended and pressure testing was recommended for abandoned lengths of FDS pipeline > 20 lf, with soil samples collected from all exposed ends of abandoned piping. Grouting of all abandoned lengths of FDS pipeline was also recommended. FDS sections where lengths of abandoned piping > 50 lf were pressure tested are considered to have met the decision criteria and are indicated as "yes", otherwise "no" is indicated and the cell is highlighted in gray.

(10) FDS sections where lengths of abandoned piping > 50 lf failed pressure testing are indicated as "yes" and highlighted in gray, otherwise "no" is indicated.

(11) Potential groundwater impacts are based on the presence of significantly affected soil at depth (e.g., > 10 ft bgs), where the reported groundwater at the Site is generally within 15 ft of the affected soil.

(12) For the purposes of this investigation, "overburden" refers to the soil that was excavated by the Army as part of the FDS removal program and was used as trench backfill. "Native" refers to soil that was not excavated by the Army as part of the FDS removal and remediation activities.

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Table 3
Soil Sample Laboratory Analysis Matrix
for Data Gap Analysis at the Infantry Terrace (FDS Section MT-14) Area
Presidio of San Francisco, California

FDS Section/UST	Sample Location	Estimated Depth of Refusal Encountered due to Bedrock (ft bgs) (a)	Depth of Basement Floor (ft bgs) (b)	Sample Depth (ft bgs)	Sample Depth (ft bbf)	Soil Type to Sample (c)	Analyses: TPHd and TPHfo (EPA 8015m)	Analyses: PAHs (EPA 8270C)	Data Gap Addressed
FDS Section MT-14	MT-14SB01	NA	--	2.5	--	native	*	*	Level II - excavation by Bldg 334, Ref 1
	MT-14SB02	NA	--	2.5	--	native	*	*	Level II - excavation by Bldg 334, Ref 1
	MT-14SB03	NA	--	2.5	--	native	*	*	Level II - excavation by Bldg 334, Ref 1
	MT-14SB04	NA	--	1.5	--	overburden		*	Level II - overburden, Ref 2
	MT-14SB05	5 (d)	--	1.5	--	overburden		*	Level II - overburden, Ref 2
	MT-14SB06	9.5 (e)	--	2.5	--	native	*		Level I - results sample FM14SB108, Ref 3
	MT-14SB07	5(d)	--	2.5	--	native	*	*	Level II - abandoned lateral, Ref 4
	MT-14SB08	5.5 (f)	--	1.5	--	overburden		*	Level II - overburden, Ref 2
	MT-14SB09	10 (g)	--	2.5, 7 (h)	--	native	*	*	Level I - results sample FM14094L02, Ref 5
	MT-14SB10	10 (i)	--	1.5	--	overburden		*	Level II - overburden, Ref 2
	MT-14SB11	10 (i)	--	1.5	--	overburden		*	Level II - overburden, Ref 2
	MT-14SB12	3.8 (j)	--	3.5	--	native	*	*	Level II - overexcavation, Ref 6
	MT-14SB13	NA	--	1.5	--	overburden		*	Level II - overburden, Ref 2
	MT-14SB14	NA	--	1.5	--	overburden		*	Level II - overburden, Ref 2
UST 334	334SB101	6.8	3.8	6.8	3.0	native	*	*	Level I - sample 334EX02(3.0)
UST 335.1	--	9.4	4.4	--	--	--	--	--	--
UST 335.2	--	9.5	4.5	--	--	--	--	--	--
UST 336	--	10	7	--	--	--	--	--	--
UST 337	337SB101	8.5	5.5	8.5, 10.5	--	--	*	*	Level I - results sample 337EX02(3.0) and 337EX03(5.0)
UST 338.1	338.1SB105	10	7	8, 11 (h)	--	native	*		Level I - lateral and vertical extent 338.1SB104
	338.1SB106			8, 11 (h)	--	native	*		Level I - lateral and vertical extent 338.1SB104
	338.1SB107			8, 11 (h)	--	native	*		Level I - lateral and vertical extent 338.1SB104
UST 338.2	--	10 (e)	7	--	--	--	--	--	--
UST 339	339SB104	11	7.5	8, 11 (h)	--	native	*		Level I - lateral and vertical extent TPH in vicinity of former UST
UST 340	--	8.4	4.4	--	--	--	--	--	--
UST 341	--	7.5 (e)	4.5	--	--	--	--	--	--
UST 342	342SB107	11	5	8, 11 (h)	--	native	*		Level I - lateral and vertical extent TPH in vicinity of former UST
UST 343	--	8.5 (e)	5	--	--	--	--	--	--
UST 344.1	--	13	8	--	--	--	--	--	--
UST 344.2	--	7 (e)	3	--	--	--	--	--	--
UST 345.1	--	11.1 (e)	8	--	--	--	--	--	--
UST 345.2	--	11.3	4	--	--	--	--	--	--

Table 3
Soil Sample Laboratory Analysis Matrix
for Data Gap Analysis at the Infantry Terrace (FDS Section MT-14) Area
Presidio of San Francisco, California

Abbreviations:
-- – not applicable
BTEX – benzene, toluene, ethylbenzene, xylenes
ft bbf – feet below basement floor
ft bgs – feet below ground surface
LTTD – low-temperature thermal desorption
PAHs – polycyclic aromatic hydrocarbons
NA - information not available
Ref - Reference to "Remarks" field for FDS Section MT-14 in Table 2 of this FSP Addendum.
TPH-fo – total petroleum hydrocarbons as fuel oil
TPH-mo – total petroleum hydrocarbons as motor oil
UST – underground storage tank

Notes:
(a) Depth to bedrock is the depth at which refusal is expected using a geoprobe rig. The actual top of the bedrock unit may be encountered at shallower depths, with a weathered surface that is relatively easily drilled or hand augered
(b) Depth of basement floor is as reported in MW, 1998.
(c) For purposes of this investigation "overburden" refers to the soil that was excavated by the Army as part of the FDS removal and used as backfill. "Native" soil is soil that was not excavated by the Army as part of the FDS removal and remediation activities.
(d) Depth to bedrock based on ltihology in soil borehole FM14SB112.
(e) Depth to bedrock based on ltihology in soil borehole FM14SB108.
(f) Depth to bedrock based on ltihology in soil borehole FM14SB103.
(g) Depth to bedrock based on lithology at former UST 336.
(h) Chemical concentration profile is to be conducted in order to asses the vertical extent of affected soil at these sample locations. The shallowest sample depth corresponds to the depth of the original Army sample where TPH concentrations were elevated and may have exceeded cleanup levels. The second sample should be collected either five feet below the visually affected soil or at a depth where the concentrations were found to be below applical cleanup levels based on previous soil sampling results.
(i) Depth to bedrock based on ltihology in soil borehole FM14SB115.
(j) Sandstone bedrock encountered at 1 ft bgs, and refusal encountered at 3.8 ft bgs in borehole FM14SB106. Therefore, assumed maximum extent of overexcavation at MT-14SB12 was 3.8 ft bgs.

References:

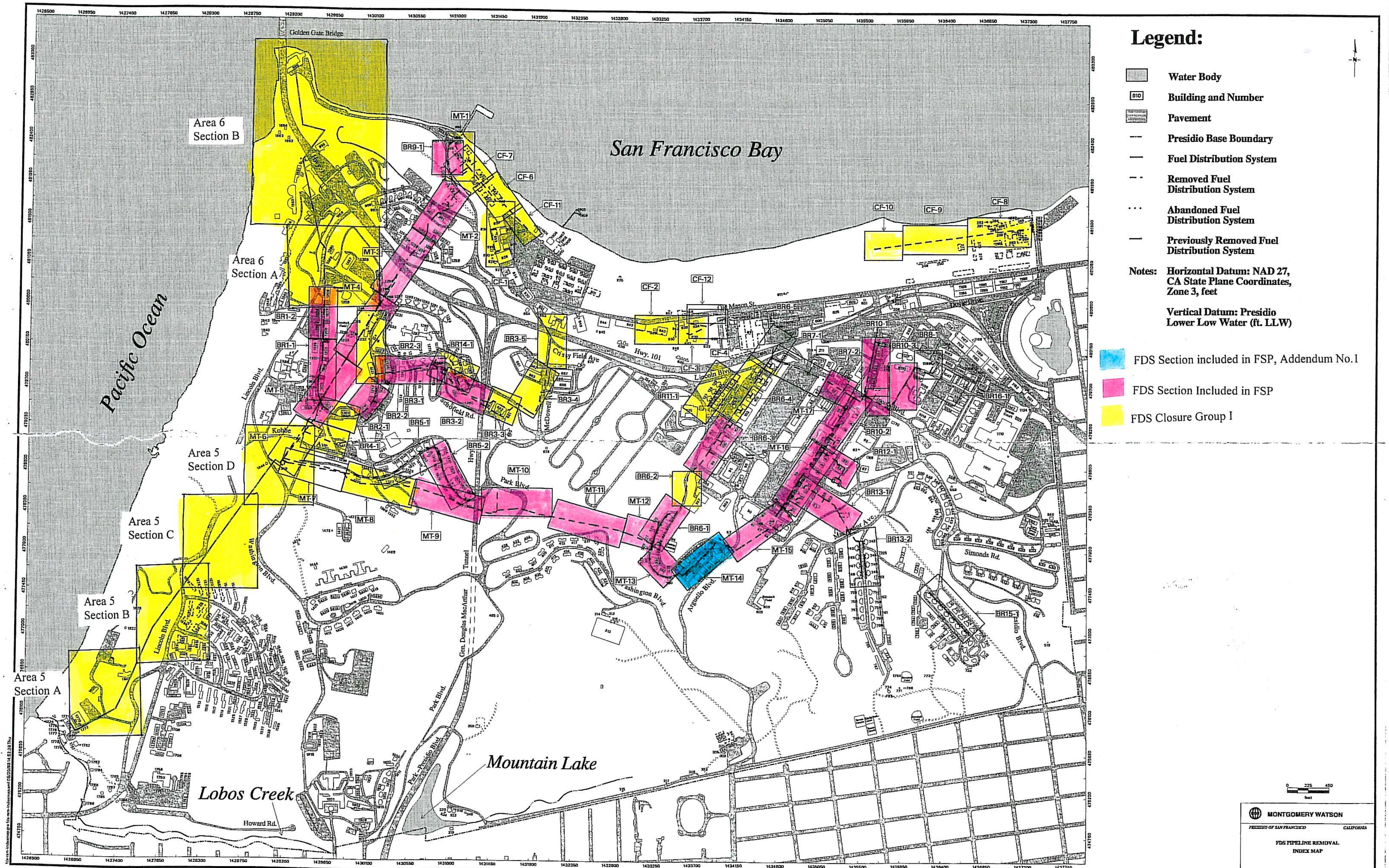
Montgomery Watson ("MW"), 1998. *Final Round 2, Group 1 Mini-Corrective Action Plans, Petroleum Sites Cleanup Program, Presidio of San Francisco, California.* August.

Table 4
Groundwater Sample Laboratory Analysis Matrix
for Data Gap Analysis at the Infantry Terrace (FDS Section MT-14) Area
Presidio of San Francisco, California

FDS Section/UST	Sample Location (a)	Screen Interval (ft bgs) (b)	Analyses TPHfo/TPHd (EPA 8015m)
FDS Section MT-14	FM14MW103 (Ref 7)	25-45	*
UST 334	--	--	--
UST 335.1	--	--	--
UST 335.2	--	--	--
UST 336	--	--	--
UST 337	--	--	--
UST 338.1	338MW101	25-45	*
UST 338.2	--	--	--
UST 339	339MW101	25-45	*
UST 340	--	--	--
UST 341	--	--	--
UST 342	342MW101	25-45	*
UST 343	--	--	--
UST 344.1	--	--	--
UST 344.2	--	--	--
UST 345.2	--	--	--
UST 345.1	--	--	--

Abbreviations:
ft bgs – feet below ground surface
Ref - Reference to "Remarks" field for FDS Section MT-14 in Table 2 of this FSP Addendum.
TPHd – total petroleum hydrocarbons as diesel
TPHfo – total petroleum hydrocarbons as fuel oil
UST - underground storage tank

Notes:
(a) Groundwater potentiometric surface at the Infantry Terrace is assumed to follow the topographic contours and monitoring well locations are based on the assumed downgradient direction.
(b) Well screen interval is based on existing wells at the Infantry Terrace Area. Actual screen interval to be confirmed in field based on encountered conditions.



Legend:
Water Body
Building and Number
Pavement
Presidio Base Boundary
Fuel Distribution System
Removed Fuel Distribution System
Abandoned Fuel Distribution System
Previously Removed Fuel Distribution System
Notes: Horizontal Datum: NAD 27, CA State Plane Coordinates, Zone 3, feet
Vertical Datum: Presidio Lower Low Water (ft. LLW)
FDS Section included in FSP, Addendum No.1
FDS Section Included in FSP
FDS Closure Group I
San Francisco Bay
Pacific Ocean
Golden Gate Bridge
Mountain Lake
Lobos Creek
Area 6 Section B
Area 6 Section A
Area 5 Section D
Area 5 Section C
Area 5 Section B
Area 5 Section A
MT-1
MT-2
MT-3
MT-4
MT-5
MT-6
MT-7
MT-8
MT-9
MT-10
MT-11
MT-12
MT-13
MT-14
MT-15
MT-16
MT-17
CF-1
CF-2
CF-3
CF-4
CF-6
CF-7
CF-8
CF-9
CF-10
CF-11
CF-12
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BR1-2
BR2-1
BR2-2
BR2-3
BR3-1
BR3-2
BR3-3
BR3-4
BR3-5
BR4-1
BR5-1
BR5-2
BR6-1
BR6-2
BR6-3
BR6-4
BR6-5
BR7-1
BR7-2
BR8-1
BR9-1
BR10-1
BR10-2
BR10-3
BR11-1
BR12-1
BR13-1
BR13-2
BR14-1
BR15-1
BR16-1
Lincoln Blvd.
Washington Blvd.
Park Blvd.
Crissy Field Ave
Hwy. 101
Old Mason St.
McDowell
Schofield Rd.
Kobbe
Arguello Blvd.
MacArthur Ave.
Simonds Rd.
Presidio Blvd.
Gen. Douglas MacArthur Tunnel
Park Presidio Blvd.
Howard Rd.
MONTGOMERY WATSON
PRESIDIO OF SAN FRANCISCO
CALIFORNIA
FDS PIPELINE REMOVAL INDEX MAP

FORMER UST 334

Sample ID	Depth (ft bgs)	TPHi	PAHi	TPHd	TPHfo	cPAHs
334EX02(3.0)	6.8	**>1,380**	--	--	--	--
334EX03(5.0)	8.8	<1,380	**>5.52**	480	680	<0.0017
334EX03 Duplicate(5.0)	8.8	<1,380	--	390	580	--
334EX04(0.5)	4.3	<1,380	<5.52	350	660	--

FORMER UST 335.1

Sample ID	Depth (ft bgs)	TPHi	PAHi	TPHd	TPHfo
335.1EX01(0.5)	4.9	<1,380	<5.52	870	**3,300**
335.1EX03(5.0)	9.4	**>1,380**	**>5.52**	960	1,100

FORMER UST 335.2

Sample ID	Depth (ft bgs)	TPHi	PAHi	TPHd	TPHfo
335.2EX01(3.0)	6.8	<1,380	<5.52	14	9.2
335.2EX02(0.5)	4.3	<1,380	<5.52	5.0	19
335.2EX03(3.0)	6.8	<115	NA	--	--
335.2EX06(0.5)	4.3	<1,380	<5.52	1.7	3.7

FORMER UST 336

Sample ID	Depth (ft bgs)	TPHi	PAHi	TPHd	TPHfo
336EX01(1.0)	8	<1,380	<5.52	33	36
336EX02(3.0)	10	NA	NA	**2,000**	**3,300**
336EX03(2.0)	9	<1,380	<5.52	3.0	17

FORMER UST 337

Sample ID	Depth (ft bgs)	TPHi	PAHi
337EX01(0.5)	6	<1,380	<5.52
337EX02(3.0)	8.5	**>1,380**	NA
337EX03(5.0)	10.5	**>1,380/ >1,380**	**>5.52**/ NA

FORMER UST 338.1

Sample ID	Depth (ft bgs)	TPHi	PAHi	TPHd	TPHfo	cPAHs
338.1EX01(0.5)	7.5	<1,380	<5.52	3.3	11	--
338.1EX02(2.0)	9	--	--	**6,000**	**8,500**	--
338.1EX04(3.0)	10	--	--	**14,000**	**20,000**	--
338.1EX05(1.5)	8.5	--	--	<1.2	3.3	--

Sample ID	Depth (ft bgs)	TPHd	TPHfo	cPAHs
338.1SB101(1)	8	**3,400 (c)**	**3,200 (f)**	1.5
338.1SB101(1.5)	8.5	280 (c)(d)	380 (f)	0.99
338.1SB101(2.5)	9.5	8.1 (c)(d)	10 (f)	<0.073
338.1SB102(1)	8	<1.2	<5.9	<0.079
338.1SB102(2)	9	<1.1	<5.4	<0.073
338.1SB103(3.5)	10.5	3.5 (c)(d)	<5.4	<0.140
338.1SB104(1)	8	**16,000 (c)**	**10,000 (f)**	<1.9
DUP081105 338.1SB104(1.5-2)	8.5	**16,000 (c)**	**6,700 (f)**	0.8
338.1SB104(2)	9	**15,000 (c)**	**9,500 (f)**	<0.84

FORMER UST 338.2

Sample ID	Depth (ft bgs)	TPHi	PAHi	TPHd	TPHfo
338.2EX01(4.5)	11.5	<115	<5.52	81	120
338.2EX02(3.0)	10	<1,380	NA	NA	NA
338.2EX03(1.0)	8	<1,380	<5.52	8.6	42

FORMER UST 339

Sample ID	Depth (ft bgs)	TPHi	PAHi	TPHd	TPHfo	cPAHs
339EX01(4.0)	11.5	**>1,380**	**>5.52**	1,200	850	5.6
339EX01 Duplicate(4.0)	11.5	**>1,380**	--	1,300	930	--
339EX02(3.5)	11	**>1,380**	--	--	--	--
339EX03(2.0)	9.5	--	--	**1,700**	1,300	--
339EX04(2.0)	9.5	--	--	**1,600**	1,100	--
339EX05(1.5)	9	--	--	**1,900**	1,300	--
339EX06(0.5)	8	<1,380	<5.52	290	1,200	--

Sample ID	Depth (ft bgs)	TPHd	TPHfo	cPAHs
339SB101(1)	8.5	**3,600 (c)**	**3,800 (f)**	<0.43
DUP 081205(3-3.5) 339SB101(1)	10.5	1,700 (c)	1,000 (f)	0.93
339SB101(3.5)	11	2,100 (c)	1,100 (f)	0.39
339SB102(2)	9.5	**1,500(c)**	830 (f)	<0.077
339SB102(3.5)	11	2.2 (d)	<6.1	<0.082
339SB103(2)	9.5	**1,400 (c)**	830 (f)	<0.230
339SB103(3.5)	11	54 (c)	36 (f)	<0.076

FORMER UST 340

Sample ID	Depth (ft bgs)	TPHi	PAHi	TPHd	TPHfo
340EX01(0.5)	4.9	<1,380	<5.52	410	**2,100**
340EX02(5.0)	9.4	NA	NA	120	110
340EX03(2.0)	6.4	NA	NA	**3,000**	**2,900**
340EX04(4.0)	8.4	NA	NA	**3,700**	**3,800**

FORMER UST 341

Sample ID	Depth (ft bgs)	TPHi	PAHi	TPHd	TPHfo
341EX01(4.0)	8.5	<1,380	<5.52	73	83
341EX02(3.0)	7.5	**>1,380**	NA	NA	NA

FORMER UST 342

Sample ID	Depth (ft bgs)	TPHi	PAHi	TPHd	TPHfo	cPAHs
342EX01(4.5)	9.5	**>1,380**	--	--	--	--
342EX02(6)	11	**>1,380**	**>5.52**	800	720	0.26
342EX02 Duplicate(6)	9.5	**>1,380**	--	690	590	--
342EX03(0.5)	5.5	<1,380	<5.6	**1,500**	**3,600**	--
342EX03 Duplicate(0.5)	5.5	<1,380	--	850	**2,700**	--

Sample ID	Depth (ft bgs)	TPHd	TPHfo	cPAHs
342SB101(2)	7	200 (c)	170 (f)	<0.200
342SB101(4)	9	**2,600 (c)**	1,700 (f)	<0.390
342SB101(5)	10	1,100 (c)	650 (f)	<0.08
342SB102(3.5)	8.5	**6,300 (c)**	**3,300 (f)**	0.93
DUP-1-081505 342SB102(5.5-6)	10.5	2,200 (c)	1,500 (f)	0.76
342SB102(6)	11	3,200	2,000	<0.41
DUP-2-081505 342SB103(2-2.5)	7	**5,300 (c)**	**2,700 (f)**	<0.24
342SB103(2.5)	7.5	**4,200 (c)**	**2,700 (f)**	<0.39
342SB103c(5)	10	**2,300 (c)**	1,700 (f)	<0.42

FORMER UST 343

Sample ID	Depth (ft bgs)	TPHi	PAHi	TPHd	TPHfo	cPAHs
343EX01(0.5)	5.5	<1,380	<5.52	200	430	--
343EX02(3.0)	8	**>1,380**	--	--	--	--
343EX03(4.0)	9	**>1,380**	**>5.52**	**1,700**	1,700	--

Sample ID	Depth (ft bgs)	TPHd	TPHfo	cPAHs
343SB101(2.5)	7.5	--	--	--
343SB101(3.5)	8.5	530 (c)	380 (f)	<0.36
343SB102(3)	8	240 (c)(d)	270 (f)	<0.15
343SB102(4.5)	9.5	**2,500 (c)**	**1,900 (f)**	<0.39
343SB102(5.5)	10.5	170 (c)(d)	120 (f)	<0.15
343SB103(3.5)	8.5	<1.1	<5.4	<0.071
343SB103(5)	10	<1.1	<5.4	<0.072

FORMER UST 344.1

Sample ID	Depth (ft bgs)	TPHi	PAHi	TPHd	TPHfo
344.1EX01(0.5)	8.5	<1,380	<5.52	<1.2	2.2
344.1EX02(3.0)	11	<1,380	NA	NA	NA
344.1EX03(4.5)	12.5	<115	<5.52	41	110

FORMER UST 344.2

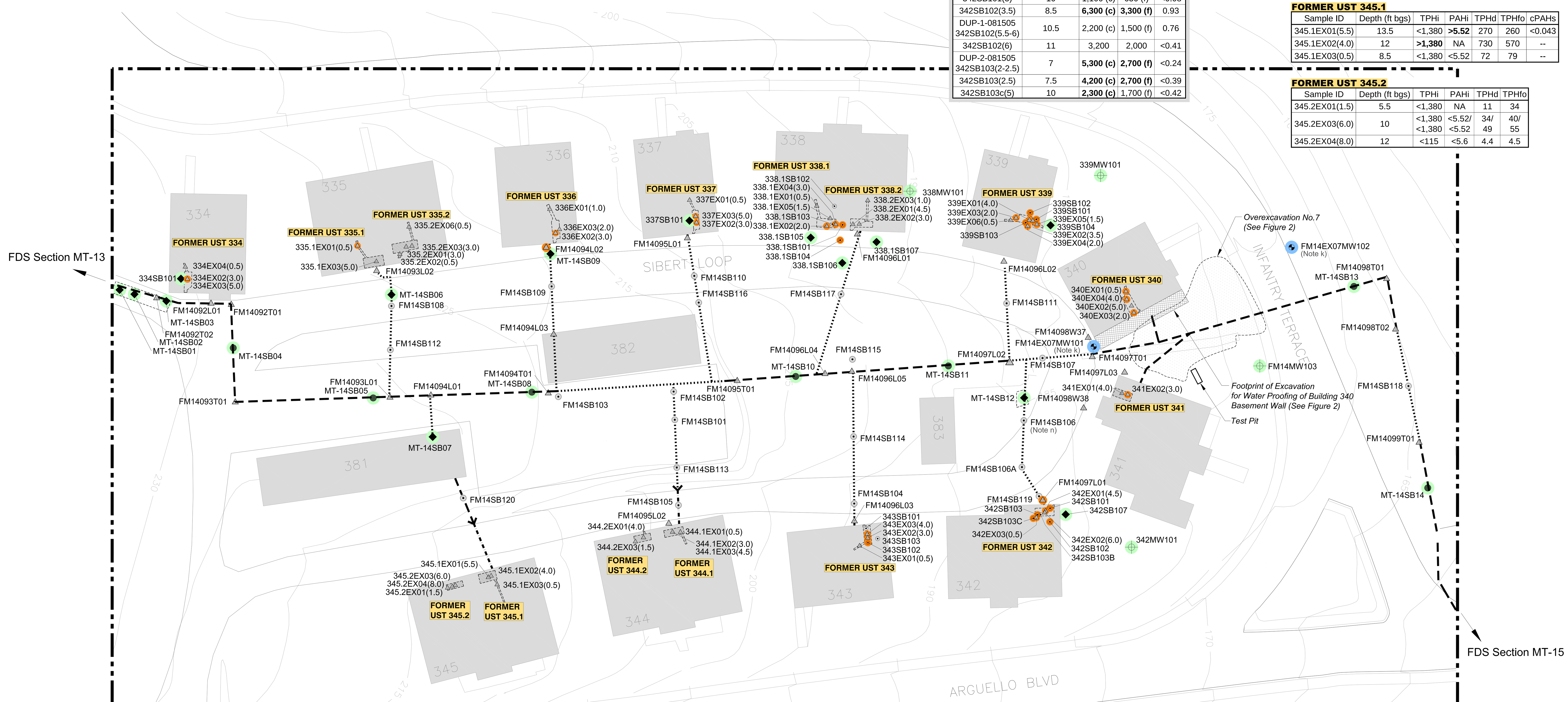
Sample ID	Depth (ft bgs)	TPHi	PAHi	TPHd	TPHfo
344.2EX01(4.0)	7	<1,380	<5.52	86	160
344.2EX03(1.5)	4.5	<1,380	<5.52	<1.1	6.0

FORMER UST 345.1

Sample ID	Depth (ft bgs)	TPHi	PAHi	TPHd	TPHfo	cPAHs
345.1EX01(5.5)	13.5	<1,380	**>5.52**	270	260	<0.043
345.1EX02(4.0)	12	**>1,380**	NA	730	570	--
345.1EX03(0.5)	8.5	<1,380	<5.52	72	79	--

FORMER UST 345.2

Sample ID	Depth (ft bgs)	TPHi	PAHi	TPHd	TPHfo
345.2EX01(1.5)	5.5	<1,380	NA	11	34
345.2EX03(6.0)	10	<1,380 <1,380	<5.52/ <5.52	34/ 49	40/ 55
345.2EX04(8.0)	12	<115	<5.6	4.4	4.5



Sample ID	TPHi	PAHi	TPHd	TPHfo	cPAHs
FM14092T02(2.5)	**>1,380**	**>5.0**	190	190	<0.0325

Sample ID	TPHi	PAHi
FM14092L01(2.0)	<115	<5.0

Sample ID	TPHi	PAHi
FM14092T01(2.5)	<700	<5.0

Sample ID	TPHi	PAHi
FM14093T01(2.0)	<115	<5.0

Sample ID	TPHi	PAHi
FM14093L02(2.5)	<575	5

Sample ID	TPHd	TPHfo	tPAHs
FM14SB108(6.5)	89 (c)(d)	60 (f)	<0.150
DUP081005 (FM14SB108(8.5-8.5))	7.7 (c)(d)	26 (f)	<0.074
FM14SB108(8.5)	3 (c)(d)	11	<0.070

Sample ID	TPHd	TPHfo	tPAHs
FM14SB112(4.5)	<1.0	<5.2	<0.070

Sample ID	TPHi	PAHi
FM14093L01(2.0)	<115	<5.0

Sample ID	TPHi	PAHi
FM14094L01(3.0)	<115	<5.0

Sample ID	TPHd	TPHfo	tPAHs
FM14SB120(6)	8.7 (c)(d)	21	<0.0073

Sample ID	TPHi	PAHi
FM14094L02(2.3)	**>575**	**>5.0**

Sample ID	TPHd	TPHfo	tPAHs
FM14SB109(4)	<1.1	<5.3	<0.070

Sample ID	TPHi	PAHi
FM14094L03(1.0)	<575	<5.0

Sample ID	TPHi	PAHi
FM14094T01(3.0)	115	<5.0

Sample ID	TPHd	TPHfo	tPAHs
FM14SB103(3)	<1.1	<5.4	<0.073
FM14SB103(5)	<1.1	<5.4	<0.072

Sample ID	TPHd	TPHfo	tPAHs
FM14SB102(13)	2.2 (c)(d)	<5.6	<0.076
FM14SB102(17.5)	4.4 (d)	<5.8	<0.078

Sample ID	TPHd	TPHfo	tPAHs
FM14SB101(11)	<1.1	<5.7	<0.075
FM14SB101(15.5)	2.4 (d)	<5.7	0.078 (i)

Sample ID	TPHd	TPHfo	tPAHs
FM14SB113(2.5)	<1.0	<5.2	<0.070

Sample ID	TPHd	TPHfo	tPAHs
FM14SB105(2.5)	30 (c)(d)	190	<0.140

Sample ID	TPHi	PAHi
FM14095L02(2.5)	807	<5.0

Sample ID	TPHi	PAHi
FM14095L01(2.0)	115	<5.0

Sample ID	TPHd	TPHfo	tPAHs
FM14SB110(5)	3.8 (c)(d)	39	<0.073
FM14SB110(9.5)	16 (c)(d)	25 (f)	0.080 (i)

Sample ID	TPHd	TPHfo	tPAHs
FM14SB116(3.5)	<1.1	<5.5	<0.073
FM14SB116(6.5)	<1.1	<5.4	<0.072

Sample ID	TPHi	PAHi
FM14095T01(2.5)	<575	<5.0

Sample ID	TPHi	PAHi
FM14096L01(2.3)	<115	<5.0

Sample ID	TPHd	TPHfo	tPAHs
FM14SB117(3.5)	27 (c)(e)	<11	<0.071

Sample ID	TPHi	PAHi
FM14096L04(2.5)	<115	<5.0

Sample ID	TPHd	TPHfo	tPAHs
FM14SB115(3.5)	<1.1	<5.6	<0.076
FM14SB115(7.5)	1.8 (c)(d)	<5.7	<0.076

Sample ID	TPHi	PAHi
FM14096L05(2.0)	115	<5.0

Sample ID	TPHd	TPHfo	tPAHs
FM14SB114(3.5)	8 (d)	<5.3	<0.071
FM14SB114(7.5)	<1.1	<5.3	<0.070

Sample ID	TPHd	TPHfo	tPAHs
FM14SB104(5)	3.7 (c)(d)	39	<0.071
DUP080905 (FMSB104(5.5-6.0))	<1.1	<5.4	<0.071
FM14SB104(8)	<1.1	<5.6	<0.073
FM14SB104(11.5)	<1.1	<5.6	<0.075

Sample ID	TPHi	PAHi
FM14096L03(2.5)	807	<5.0

Sample ID	TPHi	PAHi
FM14096L02(2.5)	<575	<5.0

Sample ID	TPHd	TPHfo	tPAHs
FM14SB111(5.5)	<1.1	<5.4	<0.073
FM14SB111(9)	<1.1	<5.4	<0.072

Sample ID	TPHi	PAHi
FM14097L02(2.0)	<575	<5.0

Sample ID	TPHd	TPHfo	tPAHs
FM14SB106A(3.5) (SUPL)	<1.1	<5.6	<0.075
FM14SB106A(6.5) (SUPL)	<1.1	<5.4	<0.072

Sample ID	TPHd	TPHfo	tPAHs
FM14SB119(1.5)	<1.1	13 (f)	<0.072
FM14SB119(3.5)	210 (c)(d)	320 (f)	<0.220

Sample ID	TPHi	PAHi
FM14097L01(2.5)	**<3,551**	**>5.0**

Sample ID	TPHd	TPHfo	tPAHs
FM14SB107(6)	<1.2	<5.8	<0.078
FM14SB107(9.5)	<1.1	<5.3	<0.073

Sample ID	TPHi	PAHi
FM14098W37(3.0)	<115	--

Sample ID	TPHi	PAHi
FM14097T01(3.5)	<115	<5.0

Sample ID	TPHi	PAHi
FM14098W38(5.0)	<115	--

Sample ID	TPHi	PAHi
FM14097L03(5.0)	<575	<5.0

Sample ID	TPHi	PAHi
FM14098T01(7.0)	<115	<5.0

Sample ID	TPHi	PAHi
FM14098T02(8.0)	<115	<5.0

Sample ID	TPHd	TPHfo	tPAHs
FM14SB118(4)	3.6 (c)(d)	20	<0.068
FM14SB118(11.5)	<1.1	<5.7	<0.077

Sample ID	TPHi	PAHi
FM14099T01(6.5)	<115	<5.0

Legend:

- Army Confirmation Soil Sampling Location Below Applicable Cleanup Levels
- Groundwater Monitoring Well (GRC, 2005)
- Soil Borehole (GRC, 2005)
- Proposed Monitoring Well Location
- Proposed Native Soil Sampling Location
- Proposed Overburden Soil Sampling Location
- Soil Sampling Location Potentially Above Applicable Cleanup Levels
- FDS Pipeline (Abandoned in Place)
- FDS Pipeline (Previously Removed by Army from 1996-1999)
- FDS Pipeline (Previously Removed)
- Site Boundary
- Historic Excavation Area
- Approximate Boundary of Former UST Excavation, Tank Closure Received Through San Francisco Department of Public Health, Notice of Completion
- Approximate Boundary of Former UST Excavation, Current Mini-CAP Site

Abbreviations:

<	less than
>	greater than
<5GW	Soil Cleanup Levels for the Protection of Water Quality at Drinking Water Standards, <5 feet above the highest groundwater (Water Board Order R2-2003-0080, Table 4). Values are the same for the Coastal Bluff and the Marina Groundwater Basin.
>5GW	Soil Cleanup Levels for the Protection of Water Quality at Drinking Water Standards, >5 feet above the highest groundwater (Water Board Order R2-2003-0080, Table 4). Values are the same for the Coastal Bluff and the Marina Groundwater Basin.
Army	U.S. Army Corps of Engineers
cPAHs	carcinogenic polycyclic aromatic hydrocarbons as diesel analyzed using laboratory analysis
CULs	applicable cleanup levels
DIESEL	total petroleum hydrocarbons as diesel analyzed using laboratory analysis
FDS	fuel distribution system
ft bbf	feet below basement floor
ft bgs	feet below ground surface
FUEL OIL	total petroleum hydrocarbons as fuel oil analyzed using laboratory analysis
GRC	GeoResources Consultants, Inc.
GWT	groundwater table
HH-Res	Soil cleanup levels for the protection of human health, residential cleanup levels (Water Board Order R2-2003-0080, Table 1)
mg/kg	milligrams per kilogram
MTBE	methyl tert-butyl ether
NA	not applicable
PAHi	polycyclic aromatic hydrocarbons analyzed using immunoassay analysis
tPAHs	total polycyclic aromatic hydrocarbons analyzed using laboratory analysis
TPHi	total petroleum hydrocarbons analyzed using immunoassay analysis
TPHd	total petroleum hydrocarbons as diesel analyzed using laboratory analysis
TPHfo	total petroleum hydrocarbons as fuel oil analyzed using laboratory analysis
TPHg	total petroleum hydrocarbons as gasoline analyzed using laboratory analysis
T&R	Treadwell & Rollo, Inc.

References:

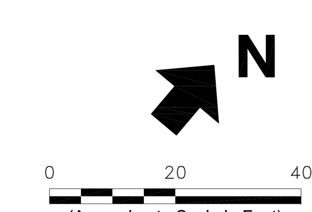
1. Basemap source: Presidio Trust, 2006 - FDS Pipeline Location digitized from Montgomery Watson, April 1999; GeoResources, 2007.
2. Monitoring well location source: Semi-Annual Groundwater Monitoring Report, Third and Fourth Quarters 2005, Presidio-Wide Quarterly Groundwater Monitoring Program, Presidio of San Francisco, CA, prepared by Treadwell & Rollo, Inc., April 2006.
3. Montgomery Watson, January 1998, Removal of Storage Tanks Inside Historic Buildings, Project Report.
4. Treadwell & Rollo, Inc., 2007, Semi-Annual Groundwater Monitoring Report, Third and Fourth Quarters 2006, Presidio-Wide Quarterly Monitoring Program, Presidio of San Francisco (Volumes I and II) April.
5. Geo/Resource Consultants. Inc. ("GRC"), 2006. Mini-CAP Additional Investigation, Excavation, and Groundwater Monitoring Well Installations to Address Former Petroleum Release Site, UST Removal Program, Presidio of San Francisco, California. August.
6. IT, 1999a. Fuel Distribution System (FDS), Basement Waterproofing As-Built, Building 340, Presidio of San Francisco. February.
7. IT, 1999b. Fuel Distribution System Closure Report, Presidio of San Francisco, CA. May.

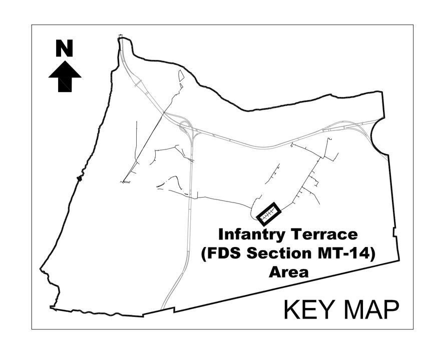
Notes:

a. All locations are approximate.
b. All laboratory soil sample results reported as mg/kg.
c. Heavier hydrocarbons contributed to quantitation.
d. Sample exhibits chromatographic pattern which does not resemble standard.
e. Sample exhibits unknown single peak or peaks.
f. Lighter hydrocarbons contributed to quantitation.
g. BTEX was not detected above reporting limits in any sample collected during the GRC 2005 sampling event.
h. Measured groundwater elevations at MT-14 ranged from approximately 23.90 to 27.79 ft bgs in well in monitoring wells FM14EX07MW101 and FMEX07MW102 between September 2006 and March 2007.
i. Phenanthrene detected at reported concentration, all other analytes for PAH were <0.075 mg/kg.
j. For samples collected along FDS Section MT-14, sample depth is in ft bgs. For samples collected within buildings, sample depth is in ft bbf.
k. TPHg and MTBE were detected at concentrations below cleanup levels in groundwater samples collected from wells FM14EX07MW101 and FMEX07MW102, at a maximum concentration of 9 ug/L at 3.3 ug/L respectively, in the vicinity of Overexcavation No. 7 (T&R, 2007).
l. Data boxes with shaded borders contain soil sample results from samples collected by GRC in 2005. Data boxes with unshaded borders contain results from soil samples collected by the Army from 1996 to 1997.
m. Concentrations in **BOLD** exceed applicable cleanup levels.
n. No soil samples collected from this borehole.

Applicable Soil Cleanup Levels (mg/kg) (Water Board Order R2-2003-0080)

Sample Depth	TPHg	TPHd	TPHfo	cPAHs
Soil 0 to 3 ft bgs	1,030	1,380	1,900	5.6
Soil 3 to 10 ft bgs	1,030	1,380	1,900	5.6
Soil > 5 ft above GWT (Note h)	5,000	15,000	15,000	NA
Soil < 5 ft above GWT (Note h)	100	115	160	111





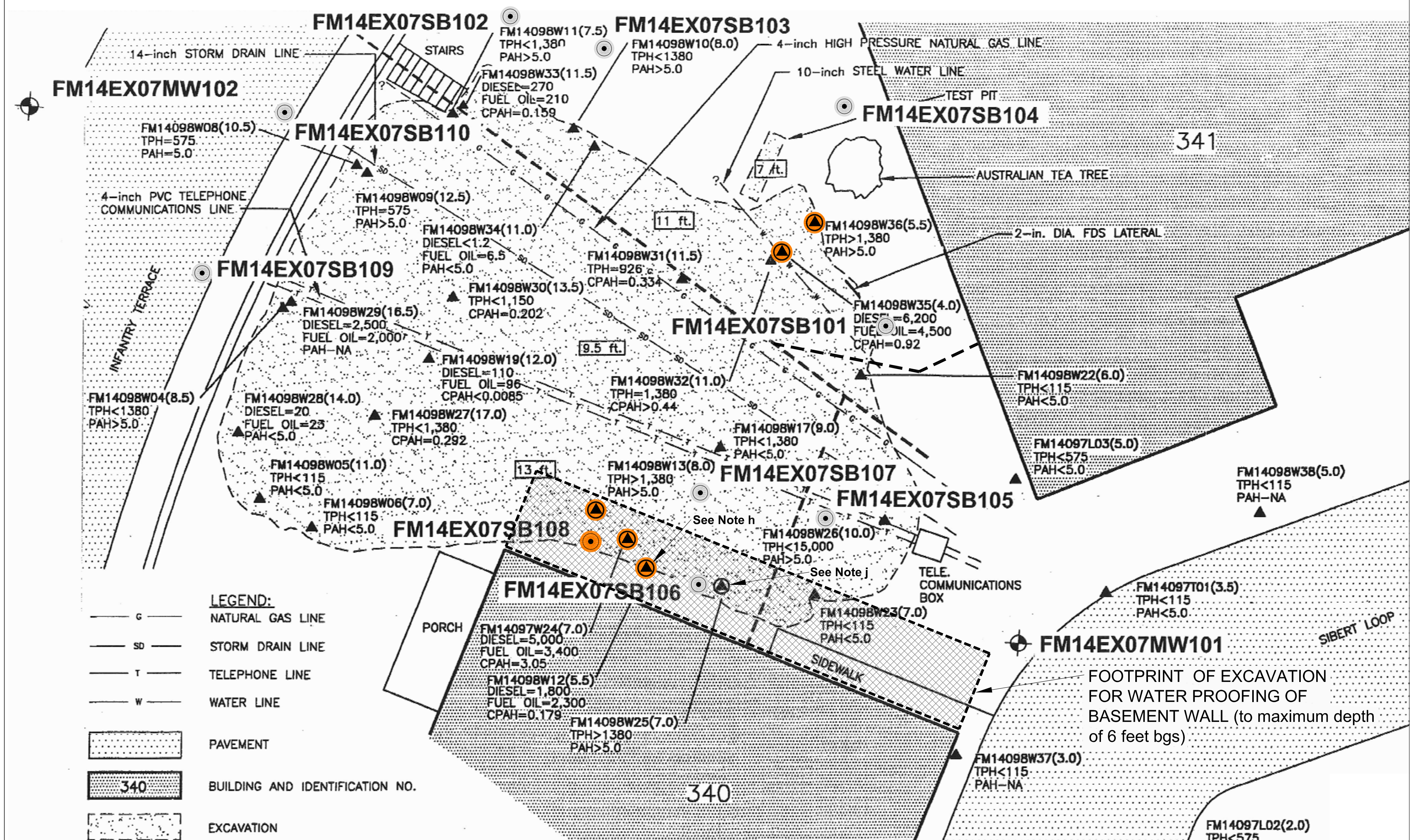
Erler & Kalinowski, Inc.

Historical Soil Sampling Data and Proposed Sampling Locations at the Infantry Terrace (FDS Section MT-14) Area

Presidio Trust
San Francisco, CA

February 2008
EKI A70004.16

Figure 1



LEGEND:

—— G ——	NATURAL GAS LINE
—— SD ——	STORM DRAIN LINE
—— T ——	TELEPHONE LINE
—— W ——	WATER LINE
	PAVEMENT
340	BUILDING AND IDENTIFICATION NO.
	EXCAVATION
	LIMIT OF EXCAVATION
	REMOVED FUEL DISTRIBUTION SYSTEM PIPELINE
NA	NOT ANALYZED
▲	SOIL SAMPLE*
FB14098W04(8.5)	SOIL SAMPLE IDENTIFICATION NO. AND (DEPTH IN FEET)
	SOIL ANALYTICAL RESULTS ABOVE SOIL ACTION LEVELS
	ABOVE APPLICABLE CLEANUP LEVELS
FM14EX07MW101	MONITORING WELL
FM14EX07SB101	SOIL BORING (GRC, 2005)

N

0 12 24

(Approximate Scale in Feet)

j. Concentrations of TPH reported as >1,380 mg/kg in soil sample FM14098W25(7.0) were unlikely to be above CULs based on laboratory analytical results from nearby soil sample FM14EX07SB106.

k. For abbreviations and references, see Figure 1.

Notes:

a. All locations are approximate.

b. Basemap source: International Technology Corporation, 1999 *Fuel Distribution System Closure Report.* GRC, 2007. *Mini-Cap Additional Investigations, Excavation, and Groundwater Well Monitoring Well Installations to Address Former Petroleum Release.*

c. Measured groundwater elevations at MT-14 ranged from approximately 23.90 to 30.04 ft bgs in well in monitoring wells FM14EX07MW101 and FM14EX07MW102 between 28 November 2005 and 4 December 2006.

d. Heavier hydrocarbons contributed to quantitation.

e. Sample exhibits chromatographic pattern which does not resemble standard.

f. Lighter hydrocarbons contributed to quantitation.

g. All laboratory soil sample results reported as mg/kg.

h. Soil in the immmediate vicinity of soil sample FM14098W12(5.5) may have been excavated as part of the basement waterproofing of Building 340.

i. Concentrations in **BOLD** exceed applicable cleanup levels.

Draft GRC Data
(IT Data Posted on Figure)

Sample ID	TPHd	TPHfo	cPAHs
FM14EX07SB101(9.5)	800 (d)	520 (f)	1.35
FM14EX07SB101(13)	640 (d)	390 (f)	1.24
FM14EX07SB101(17.5)	3,000 (d)	1,900 (f)	3.86
FM14EX07SB102(10)	<1.2	<5.9	<0.079
FM14EX07SB103(10)	<1.2	<5.8	<0.076
FM14EX07SB103(15)	<1.2	<6.0	<0.080
FM14EX07SB103(19.5)	<1.2	<5.9	<0.079
FM14EX07SB104(5)	<1.2	<5.8	<0.078
FM14EX07SB104(12)	5.8 (d)(e)	8.7	<0.078
FM14EX07SB104(19.5)	<1.2	<6.2	<0.082
DUP-1-081605 FM14X07SB105(9.5-10)	21 (d)	17 (f)	<0.072
FM14EX07SB105(10)	14 (d)(e)	9.6 (e)(f)	<0.081
FM14EX07SB105(14.5)	330 (d)	160 (f)	<0.076
FM14EX07SB105(18.5)	<1.2	<5.8	<0.076
FM14EX07SB106(10)	1000 (d)	670 (f)	0.442
FM14EX07SB106(14.5)	<1.1	<5.5	<0.074
FM14EX07SB107(8)	470 (d)	280 (f)	<0.078
FM14EX07SB107(11.5)	440 (d)	280 (f)	0.25
FM14EX07SB108(6.5)	1,100 (d)	660 (f)	1.6
DUP-2-081605 FM14EX07SB108(7-7.5)	1,300 (d)	800 (f)	1.69
FM14EX07SB108(9)	**2,800** (d)	1700 (f)	<3.800
FM14EX07SB108(10.5)	1000 (d)	520 (f)	2.72
FM14EX07SB109(5)	360 (d)	160 (f)	0.226
FM14EX07SB109(11.5)	5,700 (d)	4,400 (f)	--
FM14EX07SB109(15)	56 (d)	42 (f)	<0.230
FM14EX07SB109(19.5)	12 (d)(e)	8.2 (f)	<0.079
FM14EX07SB110(6)	<1.2	<5.8	<0.079
DUP-1-081705 FM14EX07SB110(6.5-7)	<1.1	<5.5	<0.073
FM14EX07SB110(12)	1.6 (e)	<5.8	<0.077
FM14EX07MW101(4)	1.8 (d)(e)	<5.5	<0.073
FM14EX07MW101(9)	<1.1	<5.7	<0.077
DUP 82305 FM14EX07MW101(13.5)	<1.1	<5.4	<0.072
FM14EX07MW101(14)	<1.1	<5.5	<0.072
FM14EX07MW102(10)	<1.2	<5.9	<0.079
FM14EX07MW102(20)	2.2 (d)(e)	<5.9	<0.079
FM14EX07MW102(30)	<1.2	<6.0	<0.080

Applicable Soil Cleanup Levels (mg/kg)
(Water Board Order R2-2003-0080)

Sample Depth	CUL	TPHd	TPHfo	PAHs
Soil 0 to 3 ft bgs	HH-Res	1,380	1,900	5.6
Soil 3 to 10 ft bgs	HH-Res	1,380	1,900	5.6
Soil > 5 ft above GWT (note c)	>5GW	15,000	15,000	NA
Soil < 5 ft above GWT (note c)	<5GW	115	160	111

Erler & Kalinowski, Inc.

Historical Soil Sampling Results at Overexcavation No. 7

Presidio Trust
San Francisco, CA

February 2008
EKI A70004.16

Figure 2

Appendix A

List of Acronyms/Abbreviations

Appendix A
LIST OF ACRONYMS/ABBREVIATIONS

#	Number
<	Less than
>	Greater than
<5 GW	Soil cleanup levels for the protection of water quality at drinking water standards, < 5 feet above the highest groundwater level (Water Board Order R2-2003-0080, Table 4).
>5 GW	Soil cleanup levels for the protection of water quality at drinking water standards, > 5 feet above the highest groundwater level (Water Board Order R2-2003-0080, Table 4).
Army	U.S. Army Corps of Engineers
BTEX	Benzene, Toluene, Ethylbenzene, and Xylenes
CLSM	Controlled Low Strength Material
cPAHs	Carcinogenic Polycyclic Aromatic Hydrocarbons
CSS	Confirmation Soil Sample
CULs	applicable cleanup levels
DIESEL	Total petroleum hydrocarbons as diesel analyzed using laboratory analysis
DTSC	Department of Toxic Substances Control
EKI	Erler & Kalinowski, Inc.
FDS	Fuel Distribution System
FSP	Field Sampling Plan
FSP Addendum	Field Sampling Plan Addendum
ft bbf	Feet below basement floor
ft bgs	Feet below ground surface
ft bTOC	Feet below top of casing
FUEL OIL	Total petroleum hydrocarbons as fuel oil analyzed using laboratory analysis

GRC	Geo/Resources Consultants, Inc.
GW	Groundwater Sample
GWT	Groundwater table
HH-Res	Soil cleanup levels for the protection of human health, residential cleanup levels (Water Board Order R2-2003-0080, Table 1)
IT	International Technology Corporation
Level I	Level I Decision Criteria
Level II	Level II Decision Criteria
Level III	Level III Decision Criteria
lf	linear feet
LOP	Local Oversight Program
LTTD	Low-Temperature Thermal Desorption
Mini-CAP	Miniature Corrective Action Plan
mg/kg	milligrams per kilogram
MW	Montgomery Watson, Inc.
MS/MSD	Matrix Spike/ Matrix Spike Duplicate
MTBE	Methyl tert-butyl ether
NA	Not Applicable
NFA	No Further Action
No.	Number
NPS	National Park Service
OD	Outside diameter
PAHs	Polycyclic Aromatic Hydrocarbons analyzed using laboratory analysis
PAH	Polycyclic Aromatic Hydrocarbons analyzed using immunoassay analysis
QAPP	Quality Assurance Project Plan

SFPHD	San Francisco Public Health Department
SOP	Standard Operating Procedure
SS	Soil Sample
TBD	To Be Determined
TPH	Total petroleum hydrocarbons analyzed using immunoassay analysis
TPHd	Total Petroleum Hydrocarbons as diesel using laboratory analysis
TPHfo	Total Petroleum Hydrocarbons as fuel oil using laboratory analysis
TPHg	Total Petroleum Hydrocarbons as gasoline using laboratory analysis
Trust	Presidio Trust
µg/L	micrograms per liter
USA	Underground Services Alert
UST	Underground Storage Tank
Water Board	Regional Water Quality Control Board, San Francisco Bay Region

Appendix B

SFDPH Notices of Completion

City and County of San Francisco
DEPARTMENT OF PUBLIC HEALTH
ENVIRONMENTAL HEALTH MANAGEMENT

Willie L. Brown, Jr., Mayor
Mitchell H. Katz, M.D.
Interim Director of Health

FILE

David Wilkins
US Army Corp of Engineers
604 Murray Circle
East Fort Baker Sausalito, California 94965

September 16, 1997

Dear Mr. Wilkins:

You have completed all work as specified on the application submitted by you or your agent to remove two 180 gallon underground storage tank used to store heating oil located at Building #335A and #335B at the Presidio of San Francisco in accordance with the regulations and policies of the San Francisco Department of Public Health (DPH).

Allied Technology Group, Inc. (ATG) prepared two tank removal reports dated January, 1997 and received by DPH on February 5, 1997. Each report details the removal activities associated with one of the above mentioned tanks. The reports contain the following information:

Building #335A:

- After excavating to expose the tank, residual liquids were pumped from the tank into 55 gallon drums. The tank was then cleaned with water and detergent under high pressure. The rinse water was then pumped into 55 gallon drums. Liquid from both tank removals was subsequently pumped from the drums into a vacuum truck by Erickson, Inc., and transported to PRC Patterson, in Patterson, California, under uniform hazardous waste manifest.

- On May 9, 1996, after the tank atmosphere had been inerted with solid carbon dioxide (verified by the National Park Service Fire Department), the tank was cut into pieces. The tank was removed from the excavation, inspected, loaded onto a truck and transported, under uniform hazardous waste manifest, to Erickson's facility in Richmond, California, where it was destroyed. Associated Piping within the building was removed and disposed of with the tank. Any piping outside of the building was left in place.

- Although rust and scales were apparent on the tank, no holes were noted.

- The report does not discuss the condition of the excavation, the site lithology or whether groundwater was encountered. According to the DPH inspector's report, however, the soil appeared to be a dry, loose sand.

- Two samples were taken of the soil beneath the center of the tank and analyzed for total petroleum hydrocarbons as diesel and as fuel oil. In addition, one sample was taken from beneath the product

piping approximately 6 inches below ground surface and analyzed for the same constituents.

- Excavated soil was removed from the immediate site to a dedicated soil stockpile area within the Presidio, where it will be treated for reuse.

- The excavation was then backfilled with Controlled Low Strength Material and resurfaced with concrete to match the existing basement floor.

<u>Building #335B</u>

- After excavating to expose the tank, residual liquids were pumped from the tank into 55 gallon drums. The tank was then cleaned with water and detergent under high pressure. The rinse water was then pumped into 55 gallon drums. Liquid from both tank removals was subsequently pumped from the drums into a vacuum truck by Erickson, Inc., and transported to PRC Patterson, in Patterson, California, under uniform hazardous waste manifest.

- On April 12, 1996, after the tank atmosphere had been inerted with solid carbon dioxide (the National Park Service Fire Department verified that the lower explosive level and oxygen content in the tank were below 5%), the tank was cut into pieces. The tank was removed from the excavation, inspected, loaded onto a truck and transported, under uniform hazardous waste manifest, to Erickson's facility in Richmond, California, where it was destroyed. Associated Piping within the building was removed and disposed of with the tank. Any piping outside of the building was left in place.

- Although rust and scales were apparent on the tank, no holes were noted.

- The report does not discuss the condition of the excavation, the site lithology or whether groundwater was encountered. According to the DPH inspector's report, however, the soil appeared to be a dry, loose sand

- Two samples were taken of the soil beneath the center of the tank and analyzed for total petroleum hydrocarbons as diesel and as fuel oil. In addition, one sample was taken from beneath the product piping approximately 6 inches below ground surface and analyzed for the same constituents.

- Excavated soil was removed from the immediate site to a dedicated soil stockpile area within the Presidio, where it will be treated for reuse.

- The excavation was then backfilled with Controlled Low Strength Material and resurfaced with concrete to match the existing basement floor.

Based on the analytical results of the soil sampling, further site investigation and cleanup is not required at this time. However, if additional data or other reports submitted in the future indicate that this site may pose a threat to the waters of the State, you may be required to implement additional investigation or cleanup by the Regional Water Quality Control Board or the San Francisco Department of Public Health,

Local Oversight Program (LOP).

In issuing this notice of completion, neither the City nor any of its officers or employees makes any representation that the soil and/or ground water on or about the site is free from the presence of any contamination. Nor does the City's implementation of this process relieve any person from liability for existing, additional or previously unidentified hazardous waste contamination or conditions, which cause or threaten to cause pollution or nuisance or otherwise pose a threat to water quality or public health. Neither soil and ground water analysis required pursuant to *Tri-Regional Board Staff Recommendations for Preliminary Evaluation and Investigation of Underground Tank Sites*, California Regional Water Quality Control Board, nor the issuance of this notice is intended to alter, extinguish, or transfer responsibility for compliance with Federal, State or local laws. Any changes in the present or proposed use of the site may require further site characterization and mitigation activity.

Should you have any questions regarding this Notice of Completion (NOC), please feel free to contact the undersigned inspector at (415) 252-3915.

Sue Cone

Sue Cone, Program Manager
Hazardous Materials Unified Program Agency

Edward Halbach
Environmental Health Inspector

City and County of San Francisco

Department of Public Health
Bureau of Environmental Health Management

NOTICE OF COMPLETION
UNDERGROUND STORAGE TANK REMOVAL

FILE COPY

U.S. Army Corp of Engineers
Attn: Mr. David Wilkins
604 Murray Circle
East Fort Baker Sausalito, CA 94965

May 2, 1997

Dear Mr. Wilkins,

You have completed all work as specified on your application submitted by you or your agent to remove one 180-gallon underground storage tank (UST) used to store heating oil located at Presidio, Building 341 in the City and County of San Francisco in accordance with the regulations and policies of the San Francisco Department of Public Health.

Allied Technology Group, Inc. prepared a tank removal report dated November 1996. The report contains the following information:

- Prior to the removal, the tank was cleaned and cut into sections. On May 31, 1996, the UST was removed by ATG. A tank and underlying bedrock were visually inspected for signs of potential unauthorized release of petroleum product. Several holes were noted on the tank; however, the underlying rock was not discolored or odorous.

- Two samples were collected from the center of the excavation approximately 3 and 4 feet below ground surface (bgs). The sample collected 4 feet bgs was analyzed by Onsite Environmental Labs, Inc. for total petroleum hydrocarbons as diesel (TPHd) and total petroleum hydrocarbons as motor oil (TPHmo). Both locations were analyzed by using immunoassay.

- Analytical results revealed the presence of TPHd (73 mg/kg) and TPHmo (83 mg/kg). The immunoassay results were reported to be below action level.

Based on the analytical results of the soil sampling, further site investigation and cleanup is not required at this time. However, if additional data or other reports submitted in the future indicate that this site may pose a threat to the waters of the State, you may be required to implement additional investigation or cleanup by the Regional Water Quality Control Board or the San Francisco Department of Public Health, Local Oversight Program (LOP).

In issuing this notice of completion, neither the City nor any of its officers or employees makes any representation that the soil and/or ground water on or about the site is free from the presence of any contamination. Nor does the City's implementation of this process relieve any person from liability for existing, additional or previously unidentified hazardous waste contamination or conditions, which cause or threaten to cause pollution or nuisance or otherwise pose a threat to water quality or public health. Neither soil and ground water analysis required pursuant to *Tri-Regional Board Staff Recommendations for Preliminary Evaluation and Investigation of Underground Tank Sites*, California Regional Water Quality Control Board, nor the issuance of this notice is intended to alter, extinguish, or transfer responsibility for compliance with Federal, State or local laws. Any changes in the present or proposed use of the site may require further site characterization and mitigation activity.

Should you have any questions regarding this Notice of Completion (NOC), please feel free to contact the undersigned inspector at (415) 252-3903.

Sue Cone

Sue Cone, Program Manager
Hazardous Materials Unified Program Agency

Janine Young

Janine Young
Environmental Health Inspector

City and County of San Francisco

Department of Public Health
Bureau of Environmental Health Management

NOTICE OF COMPLETION
UNDERGROUND STORAGE TANK REMOVAL

FILE COPY

Mr. David Wilkins
US Army Corps of Engineers
604 Murray Circle
East Fort Baker, Sausalito, CA 94965

June 23, 1997

Dear Mr. Wilkins,

You have completed all work as specified on your application submitted by you or your agent to removal of one (Tank 344A) 185 gallon and one (Tank 344B) 285 gallon underground storage tanks used to store heating oil located at Building 344, Presidio of San Francisco in the City and County of San Francisco in accordance with the regulations and policies of the San Francisco Department of Public Health.

Allied Technology Group, Inc prepared a tank removal report dated November 21, 1996. The report contains the following information:

- UST 344A was removed on May 30, 1996 and UST 344 B was removed on June 14, 1996. Upon removal, the tanks and tank pits were inspected for any indications of an unauthorized release of products such as corrosion holes, pits, and soil odors or discoloration. Holes and pits were not observed in the bottom of the 344B, but pits were observed in the bottom of the 344A. There was no sheen on water remaining in the pit after tank 344B was removed, but there was a sheen and free product on water remaining in the pit after tank 344 A was removed. The soil beneath either tank was not discolored or odorous.

- Immediately following the 344A tank removal, two representative soil samples were collected in native soil beneath the former UST 344A from the center of the tank pit, one at the surface and approximately 4.5 feet below site grade (bsg)and one beneath the piping. The samples were analyzed by Onsite Environmental Laboratory of Fremont for the presence of total petroleum hydrocarbons as diesel (TPHd) and as motor oil (TPHm).

- Immediately following the 344B tank removal, two representative soil samples were collected in native soil beneath the former UST 344B from the center of the tank pit, one at approximately at 4 feet bsg and one from the west end of the tank at 1.5 feet bsg. The samples were analyzed by Onsite Environmental Laboratory of Fremont for the presence of total petroleum hydrocarbons as diesel (TPHd) and as motor oil (TPHm).

- The laboratory reported the following results: For tank 344A: TPHd ranged from Non-Detected (ND) to 41 parts per million (ppm) and TPHm ranged from 2.2 to 110 ppm. For tank 344B TPHd ranged from ND to 86 ppm and TPHm ranged from 6 to 160 ppm.

Based on the analytical results of the soil sampling, further site investigation and cleanup is not required at this time. If additional data or other reports submitted in the future indicate that this site may pose a threat to the waters of the State, you may be required to implement additional investigation or cleanup by the Regional Water Quality Control Board or the San Francisco Department of Public Health, LOP.

In issuing this notice of completion, neither the City nor any of its officers or employees makes any representation that the soil and/or ground water on or about the site is free from the presence of any contamination. Nor does the City's implementation of this process relieve any person from liability for existing, additional or previously unidentified hazardous waste contamination or conditions, which cause or threaten to cause pollution or nuisance or otherwise pose a threat to water quality or public health. Neither soil and ground water analysis required pursuant to *Tri-Regional Board Staff Recommendations for Preliminary Evaluation and Investigation of Underground Tank Sites*, California Regional Water Quality Control Board, nor the issuance of this notice is intended to alter, extinguish, or transfer responsibility for compliance with Federal, State or local laws. Any changes in the present or proposed use of the site may require further site characterization and mitigation activity.

Should you have any questions regarding this Notice of Completion (NOC), please feel free to contact the undersigned inspector at (415) 252-3911. To contact the Local Oversight Program, please phone (415) 252-3920.

Sue Cone

Sue Cone, Program Manager
Hazardous Materials Unified Program Agency

Jim Ambrose

Jim Ambrose, PhD
Certified Industrial Hygienist

City and County of San Francisco

Department of Public Health
Bureau of Environmental Health Management

NOTICE OF COMPLETION
UNDERGROUND STORAGE TANK REMOVAL

FILE COPY

David Wilkins
US Army Corps of Engineers
604 Murray Circle
East Fort Baker Sausalito, California 94965

July 8, 1997

Dear Mr. Wilkins:

You have completed all work as specified on the application submitted by you or your agent to remove two 180 gallon underground storage tanks used to store heating oil located at Building #345A and #345B at the Presidio of San Francisco in accordance with the regulations and policies of the San Francisco Department of Public Health (DPH).

Allied Technology Group, Inc. (ATG) prepared two tank removal reports dated November, 1996 and received by DPH on February 5, 1997. Each report details the removal activities associated with one of the above mentioned tanks. The reports contain the following information:

Building #345A:

- After excavating to expose the tank, residual liquids were pumped from the tank into 55 gallon drums. The tank was then cleaned with water and detergent under high pressure. The rinse water was then pumped into 55 gallon drums. Liquid from both tank removals was subsequently pumped from the drums into a vacuum truck by Erickson, Inc., and transported to PRC Patterson, in Patterson, California, under uniform hazardous waste manifest.

- On or after June 7, 1996, the tank was cut into pieces, removed from the excavation, inspected, loaded onto a truck and transported, under uniform hazardous waste manifest, to Erickson's facility in Richmond, California, where it was destroyed. Associated Piping within the building was removed and disposed of with the tank. Any piping outside of the building was left in place.

- The tank was in poor condition. The DPH inspector's report indicates that there was a football sized hole, while ATG's closure report indicates that there were several holes.

- The report does not discuss the condition of the excavation, the site lithology or whether groundwater was encountered. The DPH inspector's report indicates that the soil was sand.

- Although it is not mentioned in the ATG closure report, the DPH inspection report indicates that approximately 12 inches of contaminated soil was removed before sampling.

- Two samples were taken of the soil beneath the center of the tank, one at 4 feet, sample #345.1EX02, and one at 5.5 feet, sample #345.1EX01, below the basement floor, and analyzed for total petroleum hydrocarbons as diesel (TPHd) and as fuel oil (TPHfo). In addition, one sample was taken from beneath the product piping approximately 6 inches below the basement floor, sample #345.1EX03, and analyzed for the same constituents. Sample #345.1EX02 revealed 730 mg/kg TPHd and 570 mg/kg TPHfo. Sample #345.1EX01 revealed 270 mg/kg TPHd and 260 mg/kg TPHfo. Sample #345.1EX03 revealed 72 mg/kg TPHd and 79 mg/kg TPHfo.

- Excavated soil was removed from the immediate site to a dedicated soil stockpile area within the Presidio, where it will be treated for reuse.

- The excavation was then backfilled with Controlled Low Strength Material and resurfaced with concrete to match the existing basement floor.

Building #335B

- After excavating to expose the tank, residual liquids were pumped from the tank into 55 gallon drums. The tank was cleaned with water and detergent under high pressure. The rinse water was then pumped into 55 gallon drums. Liquid from both tank removals was subsequently pumped from the drums into a vacuum truck by Erickson, Inc., and transported to PRC Patterson, in Patterson, California, under uniform hazardous waste manifest.

- On or after June 21, 1996, the tank was cut into pieces, removed from the excavation, inspected, loaded onto a truck and transported, under uniform hazardous waste manifest, to Erickson's facility in Richmond, California, where it was destroyed. Associated Piping within the building was removed and disposed of with the tank. Any piping outside of the building was left in place.

- The tank was in poor condition with several holes.

- The report does not discuss the condition of the excavation, the site lithology or whether groundwater was encountered. The DPH inspector's report indicates that the soil was sand.

- Three samples were taken of the soil beneath the tank, two at 6 feet, labeled #345.2EX03 and #345.2DUP062195 (one latter, a duplicate), and one at 8 feet, labeled #345.2EX04.

Additionally, one soil sample was taken from beneath the piping, labeled #345.2EX01, at 1.5 feet below the basement floor. Samples were analyzed for total petroleum hydrocarbons as diesel (TPHd) and as fuel oil (TPHfo). Sample #345.2EX03 revealed 34 mg/kg TPHd and 40 mg/kg TPHfo. Sample #345.2DUP062195 revealed 49 mg/kg TPHd and 55 mg/kg TPHfo. Sample #345.2EX04 revealed 4.4 mg/kg TPHd and 4.5 mg/kg TPHfo. Sample #345.2EX01 revealed 11 mg/kg TPHd and 34 mg/kg TPHfo.

- Excavated soil was removed from the immediate site to a dedicated soil stockpile area within the Presidio, where it will be treated for reuse.
- The excavation was then backfilled with Controlled Low Strength Material and resurfaced with concrete to match the existing basement floor.

Based on the analytical results of the soil sampling, further site investigation and cleanup is not required at this time. However, if additional data or other reports submitted in the future indicate that this site may pose a threat to the waters of the State, you may be required to implement additional investigation or cleanup by the Regional Water Quality Control Board or the San Francisco Department of Public Health, Local Oversight Program (LOP).

In issuing this notice of completion, neither the City nor any of its officers or employees makes any representation that the soil and/or ground water on or about the site is free from the presence of any contamination. Nor does the City's implementation of this process relieve any person from liability for existing, additional or previously unidentified hazardous waste contamination or conditions, which cause or threaten to cause pollution or nuisance or otherwise pose a threat to water quality or public health. Neither soil and ground water analysis required pursuant to *Tri-Regional Board Staff Recommendations for Preliminary Evaluation and Investigation of Underground Tank Sites*, California Regional Water Quality Control Board, nor the issuance of this notice is intended to alter, extinguish, or transfer responsibility for compliance with Federal, State or local laws. Any changes in the present or proposed use of the site may require further site characterization and mitigation activity.

Should you have any questions regarding this Notice of Completion (NOC), please feel free to contact the undersigned inspector at (415) 252-3915.

Sue Cone

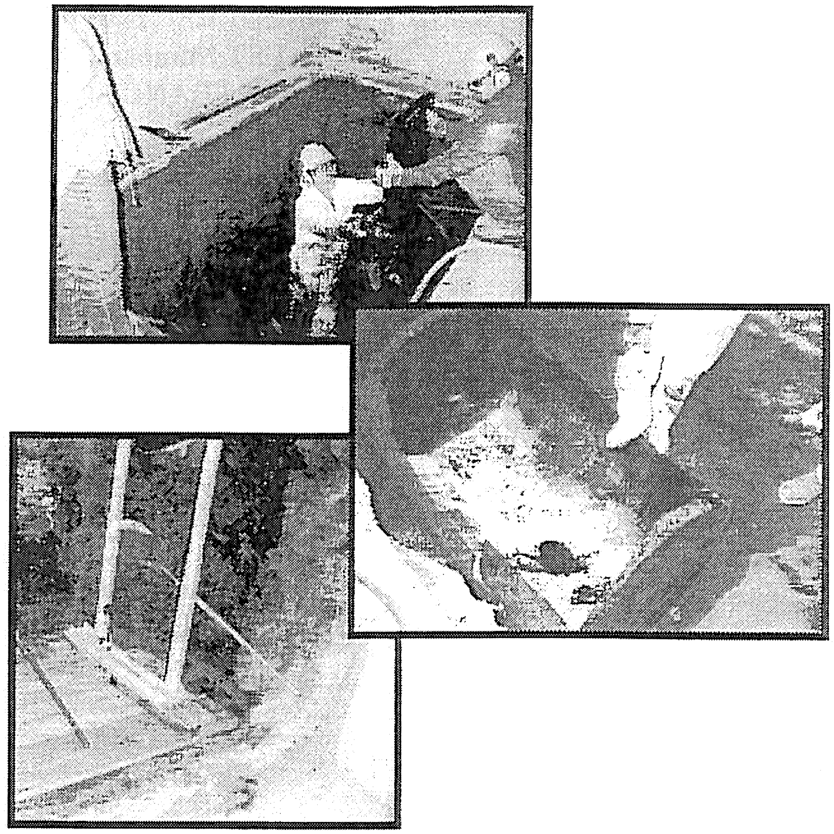
Sue Cone, Program Manager
Hazardous Materials Unified Program Agency

EHalbach

Edward Halbach
Environmental Health Inspector

Appendix C

Mini-Corrective Action Plans for USTs 337, 338.2, and 341



U.S. Army Corps of Engineers
Sacramento District

Presidio of San Francisco, California

Petroleum Sites Cleanup Program

Draft

Building 337/Tank 337 Mini-Corrective Action Plan

June 1998

MONTGOMERY WATSON

DRAFT MINI-CORRECTIVE ACTION PLAN
UST Number 337
PRESIDIO OF SAN FRANCISCO, CALIFORNIA

TANK DIMENSIONS AND PLACEMENT

Tank Volume:	190 gallons	**Depth to Top of Tank:**	1 foot
		Reference Point:	Basement Floor
Tank Diameter:	24 inches	**Groundwater Area[a]:**	No Known Groundwater
		Groundwater Basin[a]:	Marina
Tank Former Contents:	Fuel Oil	**Elevation Difference Between Ground Surface and Basement Floor:**	5.5 feet
Tank Location:	Indoor	**Depth to Groundwater**	N/A

TANK MANAGEMENT INFORMATION

Date Tank Identified	1989	**Date Site Characterization Conducted**	N/A
Date Tank Removed	5/23/96	**Soil Contamination Present**	No
Date Tank Closure Report Submitted	12/96	**Groundwater Contamination Present:**	N/A

TANK CLOSURE SUMMARY

Tank Removal Confirmation Sampling:

- Three soil samples were collected beneath the floor of the excavation following the removal of the tank (Figure 1). Two samples were collected near the center of the excavation, at the floor of the excavation and 2.0 feet below the floor of the excavation (3.0 and 5.0 feet below the basement respectively). A third sample was collected below the associated piping, 0.5 feet below the basement floor.
- The confirmation samples contained petroleum hydrocarbons in the diesel range and fuel oil range, but all fuel concentrations were less than the appropriate action levels. PAHs were not detected in soil confirmation samples (Tables 1 and 2).
- No holes were observed in the tank during excavation. Soil staining was observed in patches at the bottom of the excavation.

SITE-SPECIFIC CHARACTERISTICS

Surface water within 50 ft.?:	No	**Terrestrial Receptors Present?:**	No
Fuel Products of Concern:	Fuel Oil	**Within Aquatic Protection Zone?:**	No

Fuel Product Detected:

0-2 ft. below basement floor?	Yes
2-3 ft. below basement floor?	Yes
3-10 ft. below basement floor?	Yes
10 ft. below basement floor - >5 ft. above GW Table?	No Data.
<=5 ft. above GW Table?	No Data. Soil samples were collected at 0.5, 3.0 and 5.0 feet below the basement floor. All samples showed petroleum hydrocarbon and PAH concentrations less than the soil action levels.

SITE-SPECIFIC SOIL ACTION LEVELS (Based on SCR Order No. 96-070)[b]:			
Analyte	Action Level (mg/kg)	Criteria: Protection of	Fuel Product Detected? Max. Concentration (µg/kg)
1. Depth Range: 0-10 ft. below basement floor			Yes
Petroleum Hydrocarbons			<1,380
Diesel Range (C_{12}-C_{24})	1,380	Human Health, Residential	500
Fuel Oil Range (C_{24}-C_{36})	1,900	Human Health, Residential	690
Total Carcinogenic PAHs	5.6	Human Health, Residential	<5.52
2. Depth Range: 10 ft. below basement floor->5 ft. above Groundwater Table			No Data
Petroleum Hydrocarbons			
Diesel Range (C_{12}-C_{24})	15,000	Water Quality, Residual Saturation	
Fuel Oil Range (C_{24}-C_{36})	15,000	Water Quality, Residual Saturation	
Total Carcinogenic PAHs	-	Not Applicable	
3. Depth Range: <=5 ft. above Groundwater Table			No Data
Petroleum Hydrocarbons			
Diesel Range (C_{12}-C_{24})	115	Water Quality, Drinking Water	
Fuel Oil Range (C_{24}-C_{36})	160	Water Quality, Drinking Water	
Total Carcinogenic PAHs	111	Water Quality, Drinking Water	

ALTERNATIVES ASSESSMENT (See Figure 5-5, Basewide CAP)[c] AND MAJOR COST ESTIMATING ASSUMPTIONS

ALTERNATIVE ASSESSMENT

- All petroleum hydrocarbon and PAH concentrations are less than the appropriate action levels. Therefore, no corrective action is required for this site.

SAMPLING AND MONITORING	
Sampling Activity	Analytes and Methods (Checked if Required)
Excavation Extent Sampling Immunoassay Analyses (IA)	TPH (EPA 4030) ☐ PAH (EPA 4035) ☐
Lab. Confirmation Sampling (TPH - 10% of IA)	TPH (EPA 8015) ☐
Soil Treatment Process Sampling	Not applicable

ANTICIPATED CORRECTIVE ACTION SCHEDULE	
Corrective Action Start Date: N/A	**Corrective Action Duration:** N/A

References

[a] Montgomery Watson, 1995. Attachment B of Fuel Product Action Level Development Report. Presidio of San Francisco, California. Prepared for the U.S. Army Corps of Engineers, Sacramento District. October.

[b] Regional Water Quality Control Board (RWQCB), 1996. Site Cleanup Requirements for Petroleum-Impacted Soils. Presidio of San Francisco, California. Order No. 96-070. San Francisco Bay Region. May.

[c] Montgomery Watson, 1996. Final Basewide Corrective Action Plan. Presidio of San Francisco, California. Prepared for U.S. Army Corps of Engineers, Sacramento District. January.

ATTACHMENTS

ANALYTICAL RESULTS AND SAMPLE LOCATION MAP

TABLE 1
IMMUNOASSAY SOIL ANALYTICAL RESULTS
UST NUMBER 337 (FUEL OIL)
MINI CORRECTIVE ACTION PLAN
PRESIDIO OF SAN FRANCISCO, CALIFORNIA

Sample Location ID:		337EX01	337EX02	337EX03	337EX03 Duplicate
Sample Date:		5/23/96	5/23/96	5/23/96	5/23/96
Depth (feet below basement floor):		0.5	3.0	5.0	5.0
Analyte	**Soil Action Level**	**Concentration**			
Immunoassay-TPH[a] (mg/kg)					
TPH	1,380[b]	<1380	>1380	>1380	>1380
Immunoassay-PAH[c] (mg/kg)					
PAH	5.6[d]	<5.52	NA	>5.52	NA

Notes: TPH - Total Petroleum Hydrocarbons; PAH - Polycyclic Aromatic Hydrocarbons; mg/kg - milligrams per kilogram; NA - not analyzed.
a - TPH immunoassay results represent the sum of all petroleum hydrocarbon ranges.
b - The action level chosen for comparison to the TPH immunoassay results is the soil action level for the diesel range.
c - Immunoassay analysis for PAHs measures total carcinogenic and noncarcinogenic PAHs.
d - This action level is for total carcinogenic PAHs.

TABLE 2
LABORTORY ANALYTICAL RESULTS
UST NUMBER 337 (FUEL OIL)
MINI CORRECTIVE ACTION PLAN
PRESIDIO OF SAN FRANCISCO, CALIFORNIA

Sample Location ID:		**337EX01**	**337EX02**	**337EX03**	**337EX03 Duplicate**
Sample Date:		**5/23/96**	**5/23/96**	**5/23/96**	**5/23/96**
Depth (feet below basement floor):		**0.5**	**3.0**	**5.0**	**5.0**
Analyte	**Soil Action Level**	**Concentration**			
Immunoassay-TPH[a] (mg/kg)					
TPH	1,380[b]	<1380	>1380	>1380	>1380
Immunoassay-PAH[c] (mg/kg)					
PAH	5.6[d]	<5.52	NA	>5.52	NA

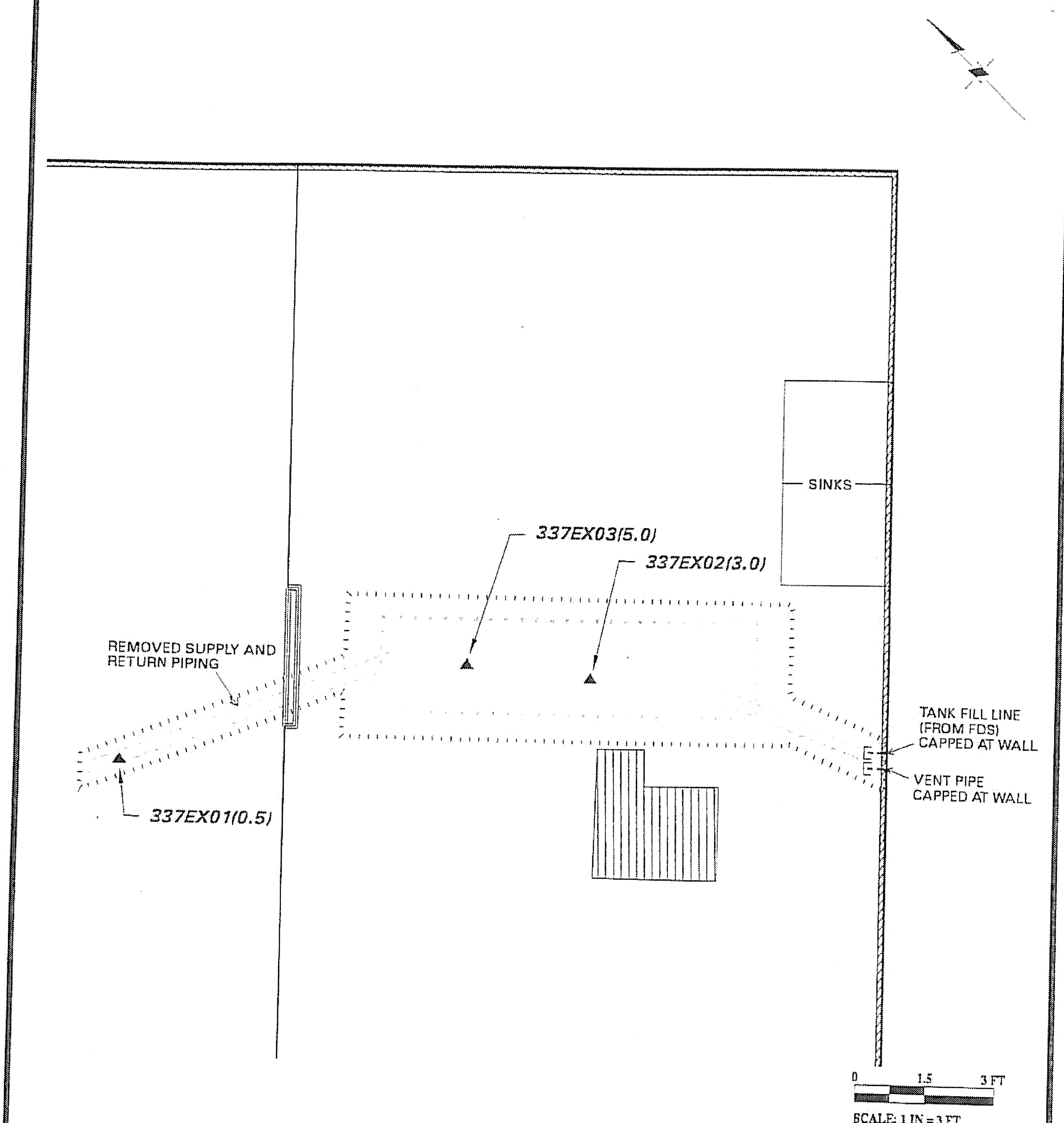
Notes: TPH - Total Petroleum Hydrocarbons; PAH - Polycyclic Aromatic Hydrocarbons; mg/kg - milligrams per kilogram; NA - not analyzed.

a - TPH immunoassay results represent the sum of all petroleum hydrocarbon ranges.

b - The action level chosen for comparison to the TPH immunoassay results is the soil action level for the diesel range.

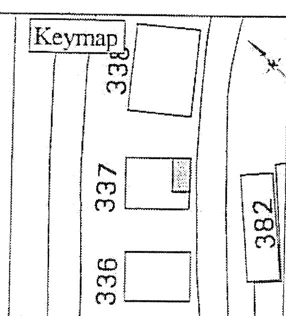
c - Immunoassay analysis for PAHs measures total carcinogenic and noncarcinogenic PAHs.

d - This action level is for total carcinogenic PAHs.



Legend:
- Outer Building Wall
- Approximate Boundary of UST Excavation
- Removed UST Footprint
- Utility Line
- Final Sample
- Pipe Riser
- Support Column

Building 337
Tank 337 Parameters:
Capacity (Gal): 190
Diameter (in): 24
Length (ft): 8
Depth to Top of Tank (ft): 1
Reference Point: Basement Floor
Depth of Excavation (ft): 3



MONTGOMERY WATSON

PRESIDIO OF SAN FRANCISCO — CALIFORNIA

INDOOR TANK REMOVAL
SAMPLE LOCATION MAP
BUILDING 337 - UST 337

FIGURE 1

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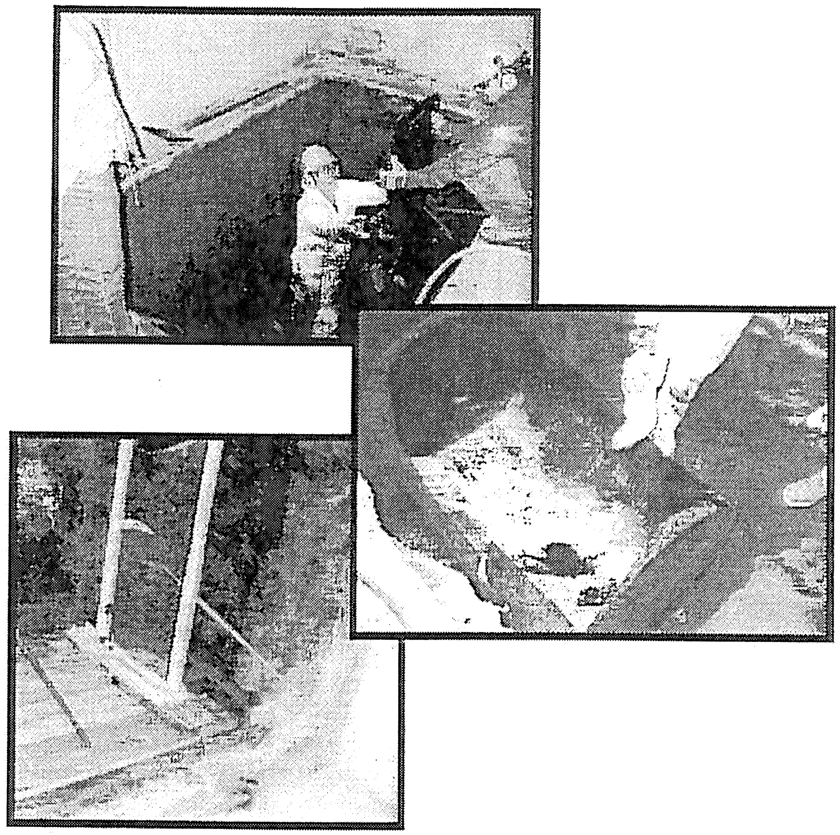


U.S. Army Corps
of Engineers
Sacramento District

Presidio of San Francisco, California

Petroleum Sites Cleanup Program

Draft

Building 338B/Tank 338.2
Mini-Corrective Action Plan

June 1998

MONTGOMERY WATSON

DRAFT MINI-CORRECTIVE ACTION PLAN
UST Number 330.1
PRESIDIO OF SAN FRANCISCO, CALIFORNIA

TANK DIMENSIONS AND PLACEMENT

Tank Volume:	190 gallons	**Depth to Top of Tank:**	0.75 feet
		Reference Point:	Basement Floor
Tank Diameter:	24 inches	**Groundwater Area[a]:**	No Known Groundwater
		Groundwater Basin[a]:	Marina
Tank Former Contents:	Fuel Oil	**Elevation Difference Between Ground Surface and Basement Floor:**	7 ft.
Tank Location:	Indoor	**Depth to Groundwater**	N/A

TANK MANAGEMENT INFORMATION

Date Tank Identified	1989	**Date Site Characterization Conducted**	N/A
Date Tank Removed	05/96	**Soil Contamination Present**	No
Date Tank Closure Report Submitted	12/96	**Groundwater Contamination Present:**	N/A

TANK CLOSURE SUMMARY

Tank Removal Confirmation Sampling:

- Two confirmation soil samples were collected beneath the floor of the excavation following the removal of the tank (Figure 1). Both samples were collected below the center of the tank at depths of 3.0 and 4.5 ft. below the basement floor (10.0 and 11.5 ft. bgs).
- When the piping leading to the tank was removed in July 1996, one additional soil sample was collected below the removed piping at a depth of 1.0 ft. below the basement floor (8.0 ft. bgs).
- All samples contained petroleum hydrocarbons in the diesel range and fuel oil range, but all fuel concentrations were less than the appropriate action levels. PAHs were not detected at concentrations greater than the appropriate soil action levels (Tables 1 and 2).
- Several holes were observed in the tank during removal. Minor staining of soil was observed during tank removal. Stained soil was removed during excavation of the tank.

SITE-SPECIFIC CHARACTERISTICS

Surface water within 50 ft.?:	No	**Terrestrial Receptors Present?:**	No
Fuel Products of Concern:	Fuel Oil	**Within Aquatic Protection Zone?:**	No

Fuel Product Detected:

0-2 ft. below basement floor?	Yes
2-3 ft. below basement floor?	Yes
3-10 ft. below basement floor?	Yes
10 ft. below basement floor - >5 ft. above GW Table?	No Data.
<=5 ft. above GW Table?	N/A. Soil samples were collected at 1.0, 3.0 and 4.5 feet below the basement floor. All samples contained petroleum hydrocarbons and PAHs less than the appropriate action levels.

SITE-SPECIFIC SOIL ACTION LEVELS (Based on SCR Order No. 96-070)[b]:			
Analyte	Action Level (mg/kg)	Criteria: Protection of	Fuel Product Detected? Max. Concentration (µg/kg)
1. Depth Range: 0-10 ft. below basement floor			Yes
Petroleum Hydrocarbons			<1,380
Diesel Range (C_{12}-C_{24})	1,380	Human Health, Residential	81
Fuel Oil Range (C_{24}-C_{36})	1,900	Human Health, Residential	120
Total Carcinogenic PAHs	5.6	Human Health, Residential	<5.52
2. Depth Range: 10 ft. below basement floor->5 ft. above Groundwater Table			No Data
Petroleum Hydrocarbons			
Diesel Range (C_{12}-C_{24})	15,000	Water Quality, Residual Saturation	
Fuel Oil Range (C_{24}-C_{36})	15,000	Water Quality, Residual Saturation	
Total Carcinogenic PAHs	-	Not Applicable	
3. Depth Range: <=5 ft. above Groundwater Table			No Data
Petroleum Hydrocarbons			
Diesel Range (C_{12}-C_{24})	115	Water Quality, Drinking Water	
Fuel Oil Range (C_{24}-C_{36})	160	Water Quality, Drinking Water	
Total Carcinogenic PAHs	111	Water Quality, Drinking Water	

ALTERNATIVES ASSESSMENT (See Figure 5-5, Basewide CAP)[c] AND MAJOR COST ESTIMATING ASSUMPTIONS

ALTERNATIVE ASSESSMENT

- All petroleum hydrocarbon and PAH concentrations are less than the appropriate action levels. Therefore, no corrective action is required for this site.

SAMPLING AND MONITORING

Sampling Activity	Analytes and Methods (Checked if Required)
Excavation Extent Sampling Immunoassay Analyses (IA)	TPH (EPA 4030) ☐ PAH (EPA 4035) ☐
Lab. Confirmation Sampling (TPH - 10% of IA)	TPH (EPA 8015) ☐
(PAH - 10% of IA)	PAH (EPA 8310) ☐
Soil Treatment Process Sampling	Not applicable

ANTICIPATED CORRECTIVE ACTION SCHEDULE

Corrective Action Start Date: N/A **Corrective Action Duration:** N/A

References

[a] Montgomery Watson, 1995. Attachment B of Fuel Product Action Level Development Report. Presidio of San Francisco, California. Prepared for the U.S. Army Corps of Engineers, Sacramento District. October.

[b] Regional Water Quality Control Board (RWQCB), 1996. Site Cleanup Requirements for Petroleum-Impacted Soils. Presidio of San Francisco, California. Order No. 96-070. San Francisco Bay Region. May.

[c] Montgomery Watson, 1996. Final Basewide Corrective Action Plan. Presidio of San Francisco, California. Prepared for U.S. Army Corps of Engineers, Sacramento District. January.

ATTACHMENTS

ANALYTICAL RESULTS AND
SAMPLE LOCATION MAP

TABLE 1
IMMUNOASSAY SOIL ANALYTICAL RESULTS
UST NUMBER 338.2 (FUEL OIL)
MINI CORRECTIVE ACTION PLAN
PRESIDIO OF SAN FRANCISCO, CALIFORNIA

Sample Location ID:		338.2EX01	338.2EX02	338.2EX03
Sample Date:		5/17/96	5/17/96	7/15/96
Depth (feet below basement floor):		4.5	3.0	1.0
Analyte	**Soil Action Level**	**Concentration**		
Immunoassay-TPH[a] (mg/kg)				
TPH	1,380[b]	<115	<1380	<1380
Immunoassay-PAH[c] (mg/kg)				
PAH	5.6[d]	<5.52	NA	<5.52

Notes: TPH - Total Petroleum Hydrocarbons; PAH - Polycyclic Aromatic Hydrocarbons; mg/kg - milligrams per kilogram; NA - not analyzed.

a - TPH immunoassay results represent the sum of all petroleum hydrocarbon ranges.

b - The action level chosen for comparison to the TPH immunoassay results is the soil action level for the diesel range.

c - Immunoassay analysis for PAH measures total carcinogenic and noncarcinogenic PAH.

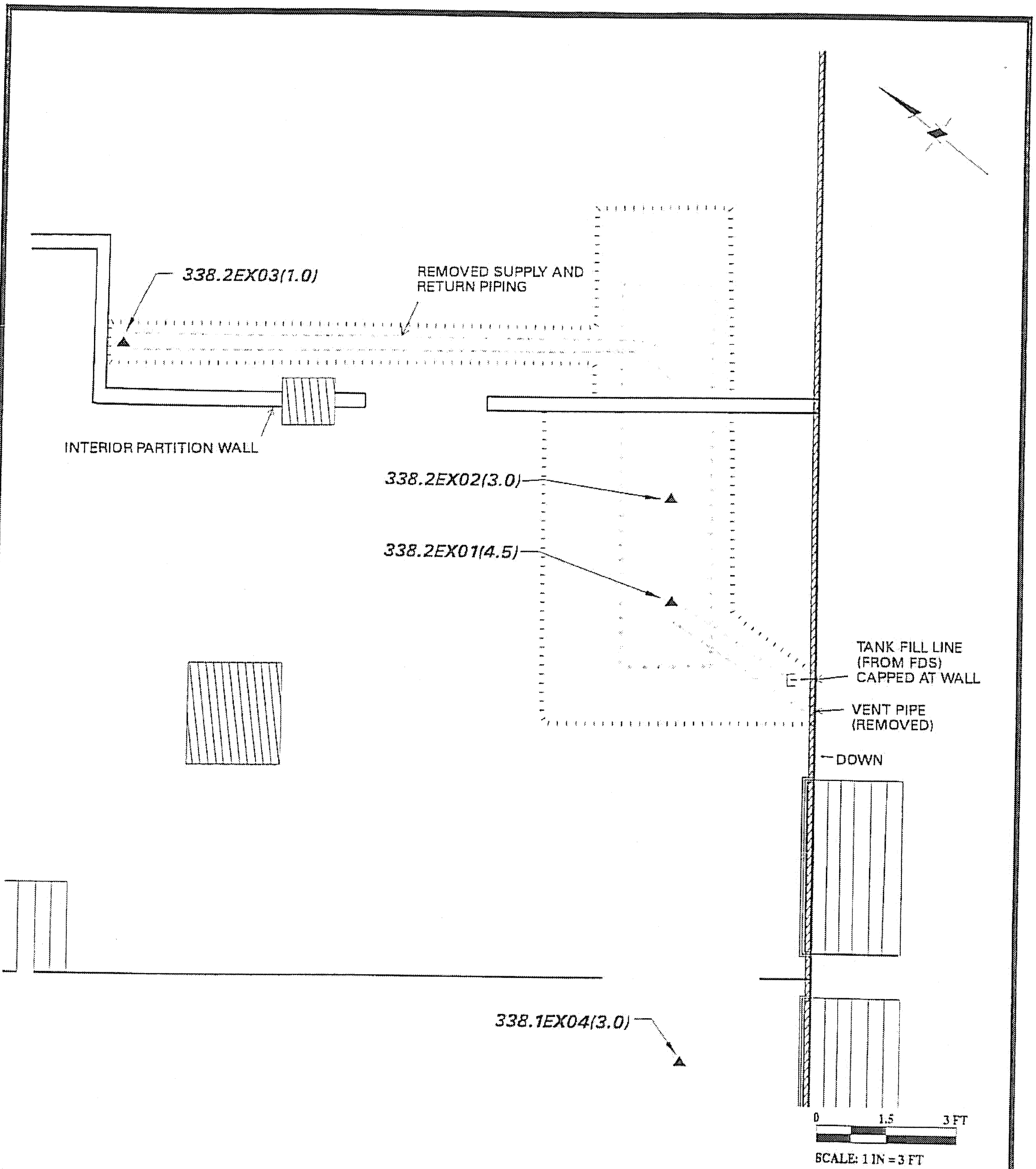
d - This action level is for total carcinogenic PAH.

TABLE 2
LABORATORY SOIL ANALYTICAL RESULTS
UST NUMBER 338.2 (FUEL OIL)
MINI CORRECTIVE ACTION PLAN
PRESIDIO OF SAN FRANCISCO, CALIFORNIA

Sample Location ID:		338.2EX01	338.2EX03
Sample Date:		5/17/96	7/15/96
Depth (feet below basement floor):		4.5	1.0
Analyte	**Soil Action Level**	**Concentration**	
Total Petroleum Hydrocarbons[a] (mg/kg)			
Diesel Range	1,380	81	8.6
Fuel Oil Range	1,900	120	42

Notes: mg/kg - milligrams per kilogram

a - Total Petroleum Hydrocarbons are quantified in two extractable ranges, C_{12} to C_{24} (diesel range) and C_{24} to C_{36} (fuel oil range).
Due to the highly varying nature of petroleum hydrocarbons at the Presidio, sample chromatograms will not match calibration standard chromatograms.



Legend:
- Outer Building Wall
- Approximate Boundary of UST Excavation
- Removed UST Footprint
- Utility Line
- Final Sample
- Pipe Riser
- Support Column

Building 338
Tank 338.2 Parameters:

Capacity (Gal): 190

Diameter (in): 24

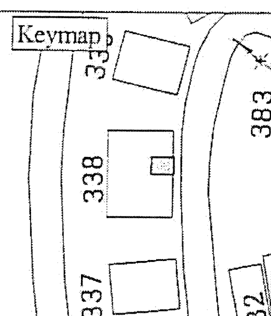
Length (ft): 8

Depth to Top of Tank (ft): 0.75

Reference Point: Basement Floor

Depth of Excavation (ft): 3

Keymap

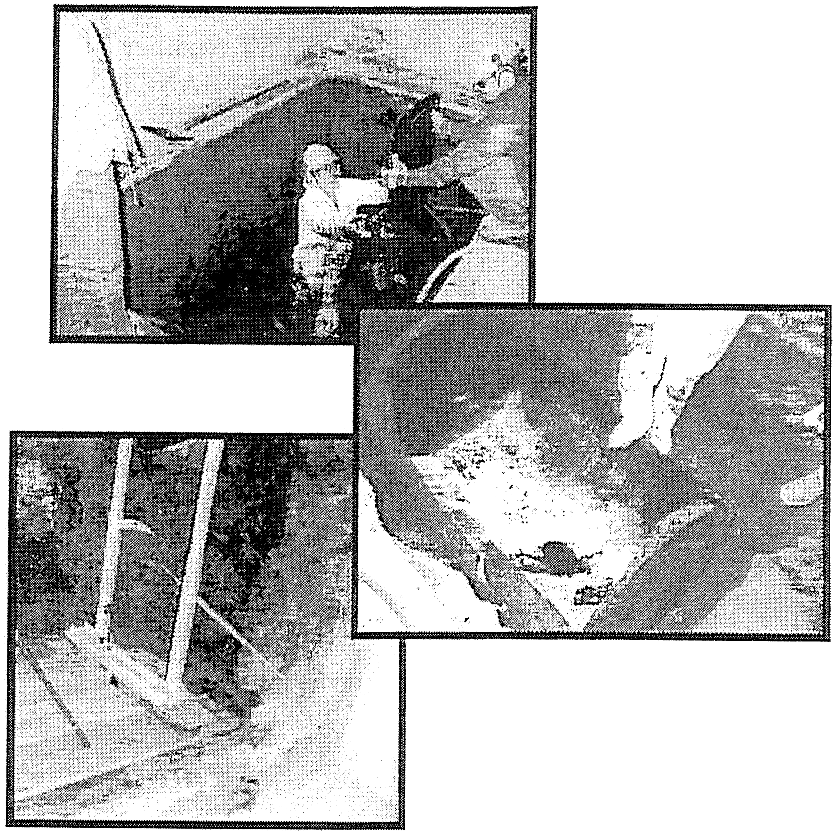


MONTGOMERY WATSON

PRESIDIO OF SAN FRANCISCO CALIFORNIA

INDOOR TANK REMOVAL
SAMPLE LOCATION MAP
BUILDING 338-B - UST 338.2

FIGURE 1



U.S. Army Corps of Engineers
Sacramento District

Presidio of San Francisco, California

Petroleum Sites Cleanup Program

Draft

Building 341/Tank 341
Mini-Corrective Action Plan

June 1998

MONTGOMERY WATSON

DRAFT MINI-CORRECTIVE ACTION PLAN
UST Number 341
PRESIDIO OF SAN FRANCISCO, CALIFORNIA

TANK DIMENSIONS AND PLACEMENT

Tank Volume:	190 gallons	**Depth to Top of Tank:**	0.8 feet
		Reference Point:	Basement Floor
Tank Diameter:	24 inches	**Groundwater Area[a]:**	No Known Groundwater
		Groundwater Basin[a]:	Marina
Tank Former Contents:	Fuel Oil	**Elevation Difference Between Ground Surface and Basement Floor:**	4.5 feet
Tank Location:	Indoor	**Depth to Groundwater**	N/A

TANK MANAGEMENT INFORMATION

Date Tank Identified	1989	**Date Site Characterization Conducted**	N/A
Date Tank Removed	5/30/96	**Soil Contamination Present**	Yes
Date Tank Closure Report Submitted	11/96	**Groundwater Contamination Present:**	N/A

TANK CLOSURE SUMMARY

Tank Removal Confirmation Sampling:

- Two soil samples were collected beneath the floor of the excavation following the removal of the tank (Figure 1). Both samples were collected near the center of the excavation, at the floor of the excavation and 1.0 feet below the floor of the excavation (3.0 and 4.0 feet below the basement respectively).
- The confirmation samples contained petroleum hydrocarbons in the diesel range and fuel oil range, but all fuel concentrations were less than the appropriate action levels. PAHs were not detected in soil confirmation samples (Tables 1 and 2).
- Several corrosion holes were observed in the tank during excavation. Soil staining was observed in the floor of the excavation and was removed.

SITE-SPECIFIC CHARACTERISTICS

Surface water within 50 ft.?:	No	**Terrestrial Receptors Present?:**	No
Fuel Products of Concern:	Fuel Oil	**Within Aquatic Protection Zone?:**	No

Fuel Product Detected:

0-2 ft. below basement floor?	No Data
2-3 ft. below basement floor?	Yes
3-10 ft. below basement floor?	Yes
10 ft. below basement floor - >5 ft. above GW Table?	No Data.
<=5 ft. above GW Table?	No Data. Soil samples were collected at 3.0 and 4.0 feet below the basement floor. Both samples showed petroleum hydrocarbon and PAH concentrations less than the soil action levels.

SITE-SPECIFIC SOIL ACTION LEVELS (Based on SCR Order No. 96-070)[b]:				
	Analyte	Action Level (mg/kg)	Criteria: Protection of	Fuel Product Detected? Max. Concentration (µg/kg)
1.	**Depth Range: 0-10 ft. below basement floor**			Yes
	Petroleum Hydrocarbons			<1,380
	Diesel Range (C_{12}-C_{24})	1,380	Human Health, Residential	73
	Fuel Oil Range (C_{24}-C_{36})	1,900	Human Health, Residential	83
	Total Carcinogenic PAHs	5.6	Human Health, Residential	<5.52
2.	**Depth Range: 10 ft. below basement floor->5 ft. above Groundwater Table**			No Data
	Petroleum Hydrocarbons			
	Diesel Range (C_{12}-C_{24})	15,000	Water Quality, Residual Saturation	
	Fuel Oil Range (C_{24}-C_{36})	15,000	Water Quality, Residual Saturation	
	Total Carcinogenic PAHs	-	Not Applicable	
3.	**Depth Range: <=5 ft. above Groundwater Table**			No Data
	Petroleum Hydrocarbons			
	Diesel Range (C_{12}-C_{24})	115	Water Quality, Drinking Water	
	Fuel Oil Range (C_{24}-C_{36})	160	Water Quality, Drinking Water	
	Total Carcinogenic PAHs	111	Water Quality, Drinking Water	

ALTERNATIVES ASSESSMENT (See Figure 5-5, Basewide CAP.)[c] AND MAJOR COST ESTIMATING ASSUMPTIONS

ALTERNATIVE ASSESSMENT

- All petroleum hydrocarbon and PAH concentrations are less than the appropriate action levels. Therefore, no corrective action is required for this site.

SAMPLING AND MONITORING	
Sampling Activity	Analytes and Methods (Checked if Required)
Excavation Extent Sampling Immunoassay Analyses (IA)	TPH (EPA 4030) ☐
	PAH (EPA 4035) ☐
Lab. Confirmation Sampling (TPH - 10% of IA)	TPH (EPA 8015) ☐
Soil Treatment Process Sampling	Not applicable

ANTICIPATED CORRECTIVE ACTION SCHEDULE	
Corrective Action Start Date: N/A	**Corrective Action Duration:** N/A

References

[a] Montgomery Watson, 1995. Attachment B of Fuel Product Action Level Development Report. Presidio of San Francisco, California. Prepared for the U.S. Army Corps of Engineers, Sacramento District. October.

[b] Regional Water Quality Control Board (RWQCB), 1996. Site Cleanup Requirements for Petroleum-Impacted Soils. Presidio of San Francisco, California. Order No. 96-070. San Francisco Bay Region. May.

[c] Montgomery Watson, 1996. Final Basewide Corrective Action Plan. Presidio of San Francisco, California. Prepared for U.S. Army Corps of Engineers, Sacramento District. January.

ATTACHMENTS

ANALYTICAL RESULTS AND
SAMPLE LOCATION MAP

TABLE 1
IMMUNOASSAY SOIL ANALYTICAL RESULTS
UST NUMBER 341 (FUEL OIL)
MINI CORRECTIVE ACTION PLAN
PRESIDIO OF SAN FRANCISCO, CALIFORNIA

Sample Location ID:		**341EX01**	**341EX02**
Sample Date:		**5/31/96**	**5/31/96**
Depth (feet below basement floor):		**4.0**	**3.0**
Analyte	**Soil Action Level**	**Concentration**	
Immunoassay-TPH[a] (mg/kg)			
TPH	1,380[b]	<1380	>1380
Immunoassay-PAH[c] (mg/kg)			
PAH	5.6[d]	<5.52	NA

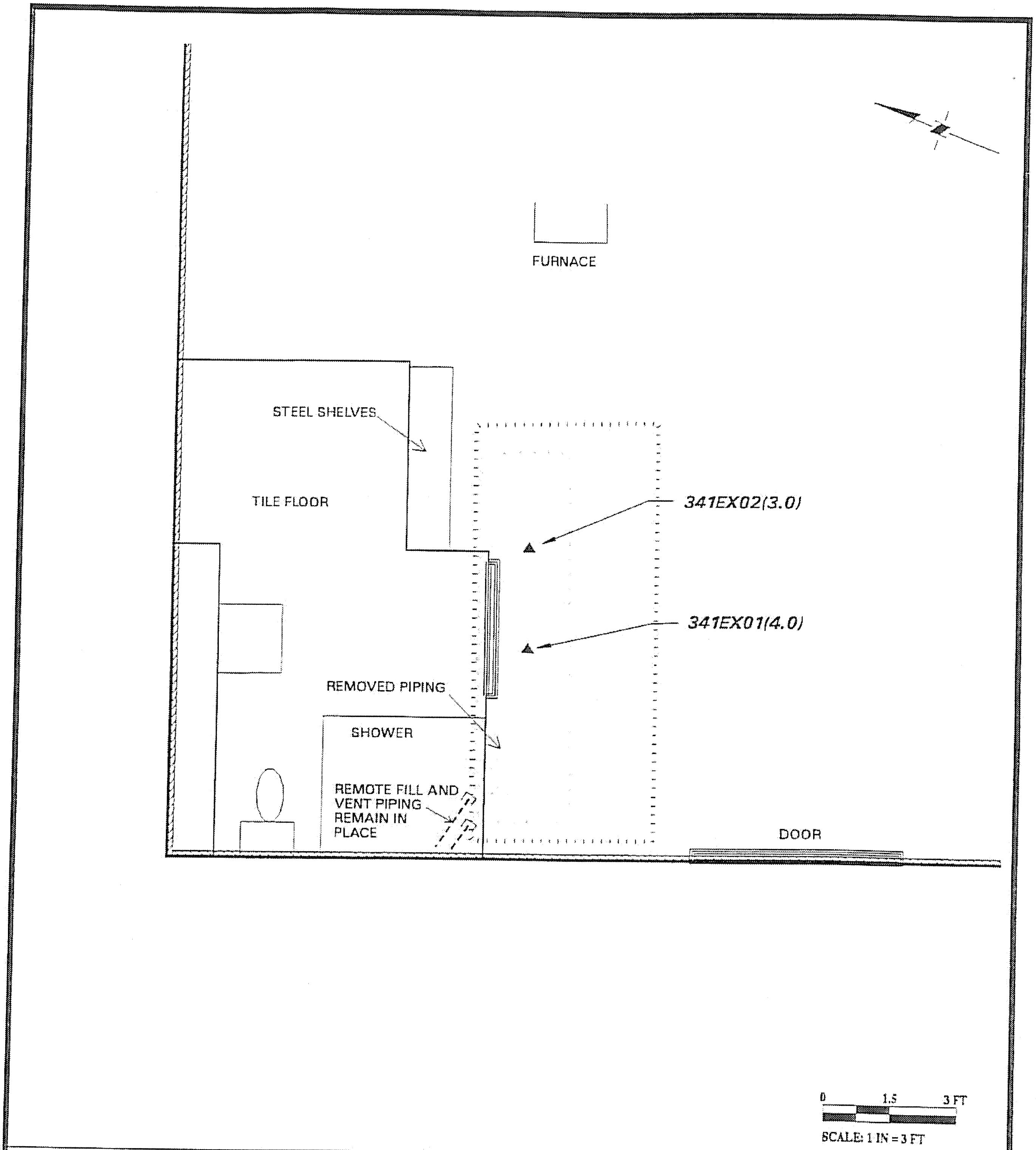
Notes: TPH - Total Petroleum Hydrocarbons; PAH - Polycyclic Aromatic Hydrocarbons; mg/kg - milligrams per kilogram; NA - not analyzed.
a - TPH immunoassay results represent the sum of all petroleum hydrocarbon ranges.
b - The action level chosen for comparison to the TPH immunoassay results is the soil action level for the diesel range.
c - Immunoassay analysis for PAHs measures total carcinogenic and noncarcinogenic PAHs.
d - This action level is for total carcinogenic PAHs.

TABLE 2
LABORATORY SOIL ANALYTICAL RESULTS
UST NUMBER 341 (FUEL OIL)
MINI CORRECTIVE ACTION PLAN
PRESIDIO OF SAN FRANCISCO, CALIFORNIA

Sample Location ID:		**341EX01**
Sample Date:		**5/31/96**
Depth (feet below basement floor):		**4.0**
Analyte	**Soil Action Level**	**Concentration**
Total Petroleum Hydrocarbons[a] (mg/kg)		
Diesel Range	1,380	73
Fuel Oil Range	1,900	83

Notes: mg/kg - milligrams per kilogram

a - Total Petroleum Hydrocarbons are quantified in two extractable ranges, C_{12} to C_{24} (diesel range) and C_{24} to C_{36} (fuel oil range).
Due to the highly varying nature of petroleum hydrocarbons at the Presidio, sample chromatograms will not match calibration standard chromatograms.



Legend:

- Outer Building Wall
- Approximate Boundary of UST Excavation
- Removed UST Footprint
- Utility Line
- ▲ Final Sample
- ○ Pipe Riser
- Support Column

Building 341
Tank 341 Parameters:

Capacity (Gal): 190

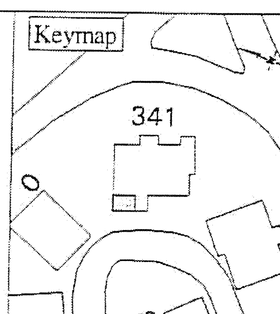
Diameter (in): 24

Length (ft): 8

Depth to Top of Tank (ft): 0.8

Reference Point: Basement Floor

Depth of Excavation (ft): 3



MONTGOMERY WATSON

PRESIDIO OF SAN FRANCISCO CALIFORNIA

INDOOR TANK REMOVAL
SAMPLE LOCATION MAP
BUILDING 341 - UST 341

FIGURE 1

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Appendix D

Standard Operating Procedures 4 and 5

SOP APPROVAL FORM

THE PRESIDIO TRUST

ENVIRONMENTAL STANDARD OPERATING PROCEDURE

WELL INSTALLATION

SOP NO. 004

REVISION NO. 00

Last Reviewed: December 2000

Quality Assurance Approved

12 JAN 01

Date

1.0 BACKGROUND

Well type, well construction, and well installation methods will vary with drilling method, well utility, subsurface characteristics, or other site-specific criteria. Specifications for well installation will be identified within a project-specific field sampling plan (FSP). A Monitoring Well Installation Record (Attachment A) will be completed for each well installed.

Well installation methods will depend somewhat on the boring method. In turn, the boring method will depend on site-specific geology and hydrogeology. Boring methods include:

- Hollow-stem auger
- Cable tool
- Rotary (mud, reverse, or air)
- Rock coring
- Direct push methods

The hollow-stem auger method is preferred in areas where subsurface materials are unconsolidated or loosely consolidated and where the depth of the boring will be generally less than 100 feet. This maximum depth is dependent on the diameter of the augers, the formation characteristics, and the strength and durability of the drilling equipment. This method is preferred because it is quick and inexpensive, addition of water into the subsurface is limited, and continuous samples can easily be collected.

Cable tool drilling is a preferred method when the subsurface contains boulders, coarse gravels, or flowing sands, or when the operational depth of the hollow-stem auger is exceeded. This method, however, is slow.

Rotary methods are generally used when other methods cannot be used. The use of drilling fluids or large amounts of water to maintain an open borehole, and the difficulty in obtaining representative samples limit this method's utility. However, this method can be used to quickly and effectively drill deep wells through consolidated or unconsolidated materials. Modifications of this method such as dual-tube drilling, drill-through casing hammers, or eccentric type drill systems can reduce the amount of fluids introduced into the well borehole.

Rock coring is an effective method when drilling in competent consolidated rock. Intact, continuous cores can be obtained, and limited amounts of fluid are required if the formations are not fractured.

Direct-push methods can be used to install shallow, water table well points in unconsolidated soils. Direct-push methods have the advantage of being rapid and relatively inexpensive, but are generally not suitable where flowing sands or consolidated material exist. In addition, this approach frequently produces a significantly more turbid sample than would be obtained from a comparable conventional monitoring well.

1.1 PURPOSE

This standard operating procedure (SOP) discusses general types of wells and minimum standards for well installation.

1.2 SCOPE

This SOP describes procedures for well installation using various methods. It includes procedures applicable to hollow-stem auger, cable tool, rotary (mud, reverse, or air), and rock coring. It also discusses more specialized wells and methods, such as direct-push installation of well points.

1.3 DEFINITIONS

None.

1.4 REFERENCES

Aller, L. 1989. *Handbook of Suggested Practices for the Design and Installation of Groundwater Monitoring Wells.* National Well Water Association (NWWA). Pages 145 through 246.

California Environmental Protection Agency. 1995. "Monitoring Well Design and Construction for Hydrogeologic Characterization." *Guidance for Ground Water Investigations.* July.

Driscoll, F.G. 1986. *Groundwater and Wells*. Second Edition. Johnson Division, UOP, Inc. St. Paul, Minnesota. Pages 438 through 442.

1.5 REQUIREMENTS AND RESOURCES

There are various options available for well installation depending on the boring method. The procedures and equipment required are outlined in the following sections.

2.0 PROCEDURES

This section details the minimum general monitoring well installation criteria and procedures. Site-specific geologic regimes may result in departures from this procedure. Specific procedures should be detailed in a project-specific FSP. Figure 1 shows a typical completed monitoring well.

All wells will be equipped with factory slotted screen. Casings and screens should be threaded and flush coupled and watertight joints should be used. Casings and screens will be selected in accordance with criteria set forth in Section 2.1. Annular seals are described in Sections 2.2 and 2.3. General monitoring well installation should follow these steps:

1. Before the installation of any casing or screen into the borehole, the casing and screen material should be carefully visually inspected for any cracks, breaks, or other defects. It should then be decontaminated (SOP No. 014 explains decontamination rationale and procedures).

2. Well casing and screens should be anchored within the borehole using centralizers.

3. The filter pack and other annular sealing materials should be installed through the auger stem or borehole casing. A tremie pipe should be used to install this material and a weighted tape should be used to tamp material. The tremie pipe is slowly raised as material is added to the annular space. When wells are constructed in temporary casing such as hollow stem augers the augers should be lifted when 1 to 2 feet of construction material has accumulated in the annulus. The casing should be lifted enough so that the accumulated material settles to within 2 to 4 inches of the bottom of the temporary casing.

4. Screens will be placed within a filter pack. This filter pack will be constructed in the manner detailed in Section 2.2 and will extend a minimum of 2 feet above and no more than 2 feet below the screened interval.

5. A fine sand collar should be installed to 2 feet above the top of the filter pack.

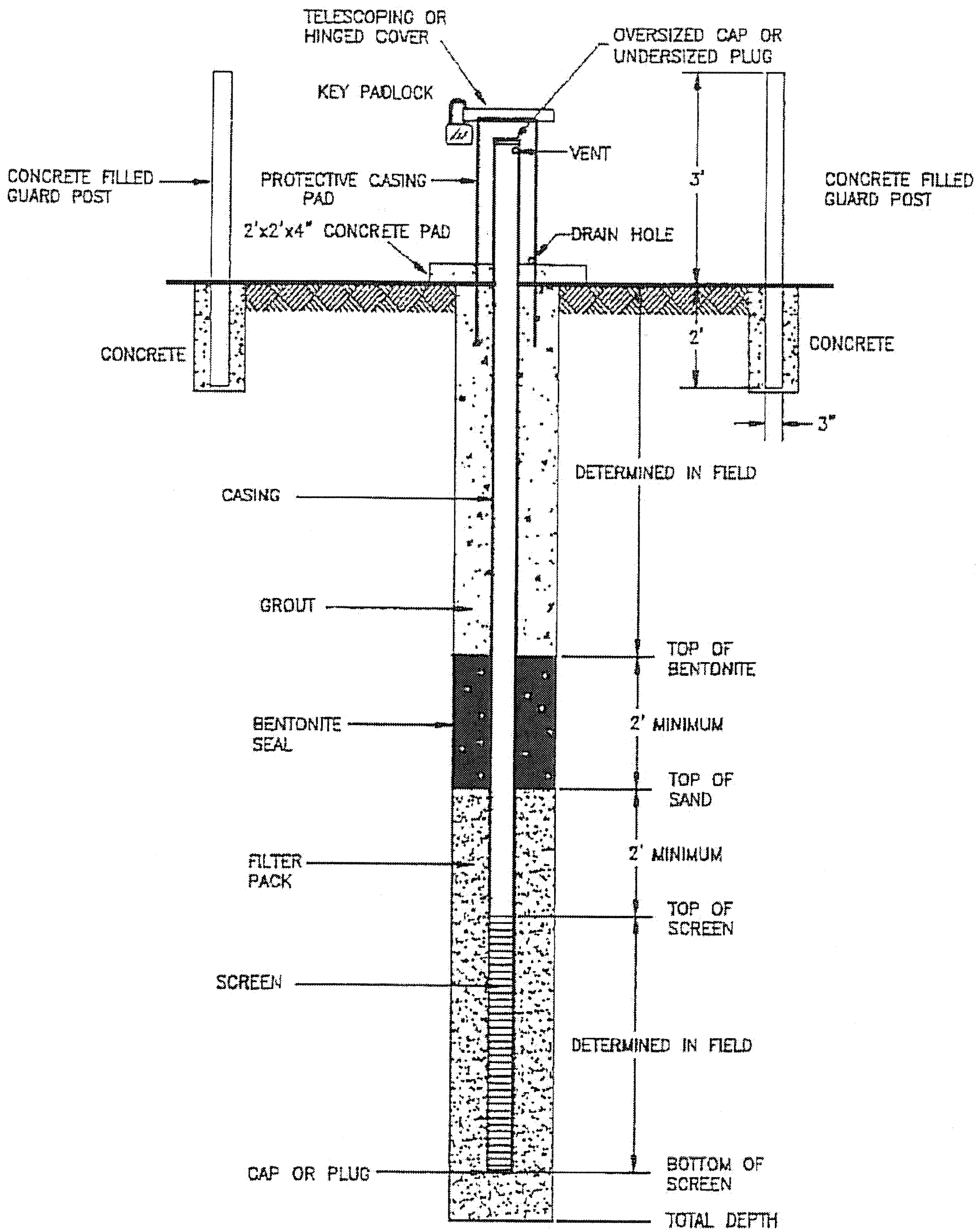
6. A minimum 2-foot thick bentonite slurry seal will be placed above the filter pack.

7. Bentonite cement slurry should be pumped through a tremie pipe into the annular space up to a point approximately 2-feet below the ground surface.

8. A protective outer casing and locking cap should then be placed in the borehole and a cement surface seal should be installed. The cement surface seal will form a pad around the monitoring well.

FIGURE 1

TYPICAL WELL CONSTRUCTION DIAGRAM



2.1 CASINGS AND SCREENS

The selection of well casing and screen materials must take into account environmental factors such as (1) geologic environment, (2) natural geochemical environment, (3) anticipated well depth, and (4) types and concentrations of known or suspected contaminants. Other nonenvironmental factors that will have an impact on the material selection include (1) anticipated life of the monitoring well, (2) drilling and installation methods, (3) cost, and (4) availability.

Inner casings and well screens should be constructed of inert, durable materials. Polyvinyl chloride (PVC) casings and screens will generally be preferred. However, PVC should not be used if the groundwater or soil contaminants react with PVC or if the well life is expected to be relatively long. Stainless steel, polytetrafluoride (Teflon®), and epoxy-fiberglass are sound well construction materials that may be employees in certain sampling environments. Epoxy-fiberglass well construction materials are relatively new to the environmental monitoring field; however, preliminary data suggests they are comparable to stainless steel, but about half the cost. Due to the recent introduction of this material into the groundwater monitoring field, local regulatory authorities should be consulted prior to the use of this material. Several states, U.S. Environmental Protection Agency regions, and U.S. Army Corps of Engineers Districts are using this material as an alternative to stainless steel.

Casing and screen joints should be threaded, and Teflon® tape should be used to assure a tight seal with Teflon® or stainless-steel components. Epoxy-fiberglass and PVC joints typically are fitted with rubber O-rings to provide a tight seal. Teflon® tape may also be applied to these joints to assure a prolonged tight seal. Under no circumstances should joints be glued or solvent sealed.

Screens will be factory-slotted. The screen slot size will be dependent on required flow rates for the well and the texture of the formation. When sieve analysis information is available for well packing material, slot sizes should be capable of retaining 90 percent of the filter pack material (see Section 2.2). When no such information is available, a default screen size of 0.01 inch (No. 10 slot) will be used.

Screen length and well diameter will depend on site-specific considerations. These include intended well use, contaminants of concern, and hydrogeology. Some considerations are as follows:

- Water table wells should have screens of sufficient length and thickness to monitor the water table and provide sufficient sample volume during high and low water table conditions.

- Wells with low recharge should have screens of sufficient length and width so that adequate sample volume can be collected.
- Wells should be screened over short enough distances to allow for monitoring of discrete migration pathways.
- Where light nonaqueous-phase liquids (LNAPL), or contamination in the upper portion of a hydraulic unit, are being monitored, the screen should be set so that the upper portion of the water-bearing zone is below the top of the screen.
- Where dense nonaqueous-phase liquids (DNAPL) are being monitored, the screen should be set within the lower portion of the water-bearing zone, just above a relatively impermeable lithologic unit.
- The screened interval should not extend across an aquiclude or aquitard.
- If contamination is known to be present and concentrated within a portion of a saturated zone, the screen should be constructed in a manner that minimizes the potential for cross-contamination within the aquifer.
- If downhole geophysical surveys are to be conducted, the casing and screen material must be of sufficient diameter and constructed of the appropriate material to allow effective use of the geophysical survey tools.
- If aquifer tests are to be conducted in a monitoring well, the slot size must allow sufficient flux to produce the required drawdown and recovery. The diameter of the well must be sufficient to house the pump and monitoring equipment and to allow sufficient water flux (in combination with the screen slot size) to produce the required drawdown or recovery.

In many instances, it may be necessary to isolate stratigraphically higher portions of the subsurface, during drilling, from the zone being monitored. In these cases, special types of drilling may be necessary. An example of this is the use of temporary or permanent borehole casing that is telescoped to smaller diameters with depth. With this approach, a large diameter casing is installed through the zone to be isolated and drilling is continued to depth through this casing. If necessary, additional smaller diameter casing can be installed to stabilize the formation or isolate progressively deeper stratigraphic units. Another alternative involves the drilling of a large diameter borehole to the base of the zone to be isolated. This borehole is then sealed with a cement-bentonite grout. When the grout has cured, the well installation borehole is drilled through the grout down to its final completion depth. Just as with the casing approach described above, progressively deeper units can be isolated by the grouting of the portion of the borehole, which penetrates, then advancing the borehole through the hardened grout.

Before installing the casing and screen, they should be fitted with centralizers to assure a uniform thickness of the annular seals. The annular seal is composed of the filter pack, sand collar, bentonite seal, and cement-bentonite grout. The annular seal should have a uniform thickness around the casing and screen of between 2 to 4 inches. Thinner seals increase the possibility that the well screen may be exposed to the formation, and thicker seals may interfere with aquifer hydraulics around the screen. The selection of the centralizer material should be based on the same criteria used to select the casing and screen material. The centralizers should be spaced at closer intervals for smaller diameter casing and screen. Two-inch casing and screen should have centralizers installed approximately every 20 feet.

2.2 FILTER PACK

The filter pack will be composed of chemically inert, uncontaminated material. The preferred filter pack material is pure silica sand.

Methods for choosing filter pack grain size should be clearly outlined in the project-specific field sampling plan. Filter pack material must be tailored to the formation material. One method for choosing the filter pack grain size is based on the method proposed by NWWA (Aller 1989). Using this method, at least one standard sieve analysis of formation material is obtained. The grain size that retains 70 percent of the material is noted. This grain size is multiplied by a factor of 4 or 6. The factor of 4 is used for coarse-grained, poorly sorted formations, and the factor of 6 is used for fine-grained, well-sorted formations. The resultant grain size is used as the 70 percent retained point for the grain size of the filter pack. A second more conservative approach is described by Driscoll (1986). In this approach, the filter pack size is based on multiplying the 50 percent retained formation grain size by 2. If formation particle-size distribution information is not available, an Ottawa grade sand, American Society for Testing and Materials (ASTM) C-778 sand, or equivalent can be considered for use. The use of a default-size filter pack becomes more tenuous in increasingly finer-grained formations. The uniformity coefficient of the filter pack should not exceed 2.5. The filter pack should have a finished uniform thickness of 2 to 4 inches.

The filter pack should extend 2 feet above the top of the well screen. A sand collar should be installed on top of the filter pack. The sand collar should be constructed from fine silica sand (0.0021- to 0.0041-inch diameter) and extend 2 feet above the filter pack. This sand collar is intended to prevent intrusion of bentonite and grout into the filter pack.

2.3 GROUT AND CEMENT

Bentonite slurry should be placed in the annular pack for a minimum of 2 feet above the fine sand collar. This slurry should be mixed at a ratio of approximately 22 pounds of dry bentonite to 7 gallons of water. This should result in 10- to 11-pound per gallon slurry. The bentonite slurry will act as a formation seal for the monitoring well borehole. Cement and bentonite grout slurry will be placed in the annular space above the bentonite slurry, generally to a point about 2 feet below ground surface. Sufficient time should be allowed for the bentonite slurry to gel to a strength able to support the cement and bentonite grout. When mixing the bentonite slurry with a low shear device such as the grout pump or a drill rig, 30 to 60 minutes of mixing should be conducted prior to placing the slurry into the well annulus. After 30 to 60 minutes of low shear mixing, the slurry should be thick enough to support the cement-bentonite grout. The cement and bentonite grout will consist of mixture of 8 gallons of water, 5 pounds of bentonite powder (approximately 5 percent of the mix), and a 94-pound sack of Portland cement. An alternative cement-bentonite grout would be a premixed commercially equivalent material. A cement surface seal will be placed at the surface. Specific construction criteria may vary. These should be detailed in the project-specific FSP.

Bentonite slurry used as a formation seal above the filter pack and sand collar can be replaced with a seal composed of bentonite pellets or chips. These materials should be added to the annulus slowly to prevent bridging. Lifts of 3 to 4 inches should be separated by sufficient time to allow settlement. Past experience has shown that natural bentonite chips have slower hydration characteristics and are not as prone to bridging as formed bentonite pellets.

Bentonite seals are not always appropriate. If they are installed in the vadose zone, they may never fully hydrate, or they can dry, creating desiccation cracks. Both situations cause seal failure. Groundwater with high chloride concentrations or total dissolved solids greater than 500 parts per million (ppm) may inhibit the full hydration of the bentonite. This could limit the effectiveness of the annular seal. The case of bentonite in areas were the seal may be exposed to high concentrations of organic solvents, hydrocarbons, organic acids, basic and natural polar-organic compounds, and neutral nonpolar organic compounds may result in a several order-of-magnitude increase in the permeability of the seal. Neat cement is an alternative to bentonite seals given any of the above environmental conditions. Neat cement is a mixture of Portland cement (ASTM C-150) and water in the ratio of 5 to 6 gallons of water to 94 pounds of cement. Type I Portland cement is the most commonly used material for this application.

2.4 OTHER COMPONENTS

The procedures below should be followed under specific circumstances. Several other well components, which may be necessary depending of project specifications, are listed below:

- **Locking Well Caps and Outer Protective Casings.** These will be placed on all completed wells. These can be either aboveground or flush mount.
- **Bumper Posts or Well Head Protection.** Protective bumper posts or other types of protective barriers should be placed around each well with an aboveground completion.
- **Telescoping or Conductor Casing.** Telescoping or conductor casing is used when wells are drilled to fairly deep depths when drilling proceeds through several separate saturated intervals, or when drilling through grossly contaminated intervals.

3.0 OTHER TYPES OF WELLS

This section discusses other types of wells that may be installed in special cases. These include well points, wells installed through multiple saturated zones, well nests, and bedrock wells.

3.1 WELL POINTS

Under certain conditions, it may be necessary to install well points. These wells are driven directly into the subsurface by sledgehammer, power impact driver, or direct push methods such as Geoprobe® or cone penetrometer testing methods. Applications include use as vadose zone monitoring or shallow piezometer wells. However, the geologic subsurface must be compatible with this method. The utility of this method is limited because the annular space is generally not sealed to the surface. These types of wells are not currently a widely accepted alternative to permanent monitoring well installations and should only be used under special circumstances.

3.2 WELLS INSTALLED THROUGH MULTIPLE SATURATED ZONES

When wells are installed through multiple saturated zones, special well construction methods have to be used to ensure well integrity and to limit the potential for cross-contamination. Generally, these types of wells are necessary if hydraulic units are separated by relatively impermeable layers. Two procedures that may be used are described below.

The borehole is advanced to the base of the first saturated zone. Casing is then anchored in the impermeable layer below and grouted to the surface. After the grouting has cured, a smaller diameter borehole is drilled through the grout. This procedure is repeated until the zone of interest is reached. After this zone is reached, a conventional well screen and riser casing is set.

Another acceptable procedure involves driving a casing through several saturated layers, while drilling ahead of the casing. This method, however, is not acceptable when a competent aquitard or aquiclude may be structurally damaged by the driven casing, because this method may result in cross-contamination of two saturated layers.

3.3 WELL NESTS

Well nests are installed when several distinct intervals in an aquifer are to be sampled at each groundwater sampling location. These wells can be completed similarly to those described in Section 2.0. These wells can be installed in a single borehole or in close proximity to each other. When installing multiple wells in a single borehole, extreme care should be exercised when placing bentonite slurry seals above the filter packs. These seals must prevent flow between the wells in the single borehole.

3.4 BEDROCK WELLS

Wells completed in bedrock will be drilled using the air or mud rotary method. Crystalline rock wells are usually drilled most efficiently with the air rotary method while consolidated sedimentary formations are drilled using either the air rotary or mud rotary method. The compressed air supply will be filtered prior to introduction into the borehole to remove oil or other contaminants. Bedrock wells may be completed as an open-hole, providing that borehole cave-in is not a possibility.

Bedrock wells will be advanced with air or mud rotary methods until a minimum of 5 feet of competent rock has been drilled. Minimum borehole diameter will be 8 inches. The drill string will then be pulled from the borehole and 6-inch I.D. Schedule 80 or 40 PVC casing inserted. Portland cement/bentonite grout will be pumped into the hole and up the annular space outside the casing. After the grout has set (minimum of 24 hours), the cement will be drilled out and the borehole advanced to the desired depth. Figure 2 shows typical construction details for an open-hole bedrock well. The preferred method of well completion for the bedrock wells will be open-hole. However, if the open borehole is subject to cave-in, the well(s) will be completed as screened and cased sand-packed wells.

ATTACHMENT A

MONITORING WELL INSTALLATION RECORD

MONITORING WELL INSTALLATION RECORD

MONITORING WELL

MONITORING WELL NO.: ____________
PROJECT: ____________
SITE: ____________
BOREHOLE NO.: ____________
WELL PERMIT NO.: ____________
TOC TO BOTTOM OF WELL: ____________

DRILLING INFORMATION

DRILLING BEGAN:
DATE: ________ TIME: ________
WELL INSTALLATION BEGAN:
DATE: ________ TIME: ________
WELL INSTALLATION FINISHED:
DATE: ________ TIME: ________
DRILLING CO.: ____________
DRILLER: ____________
LICENSE: ____________
DRILL RIG: ____________
DRILLING METHOD:
☐ HOLLOW STEM AUGER
☐ AIR ROTARY
☐ OTHER: ____________
DIAMETER OF AUGERS:
ID: ________ OD: ________

WELL CASING

☐ SCHEDULE 40 PVC
☐ OTHER: ____________
PRODUCT: ____________
MFG. BY: ____________
CASING DIAMETER:
ID: ________ OD: ________
LENGTH OF CASING: ____________

WELL SCREEN

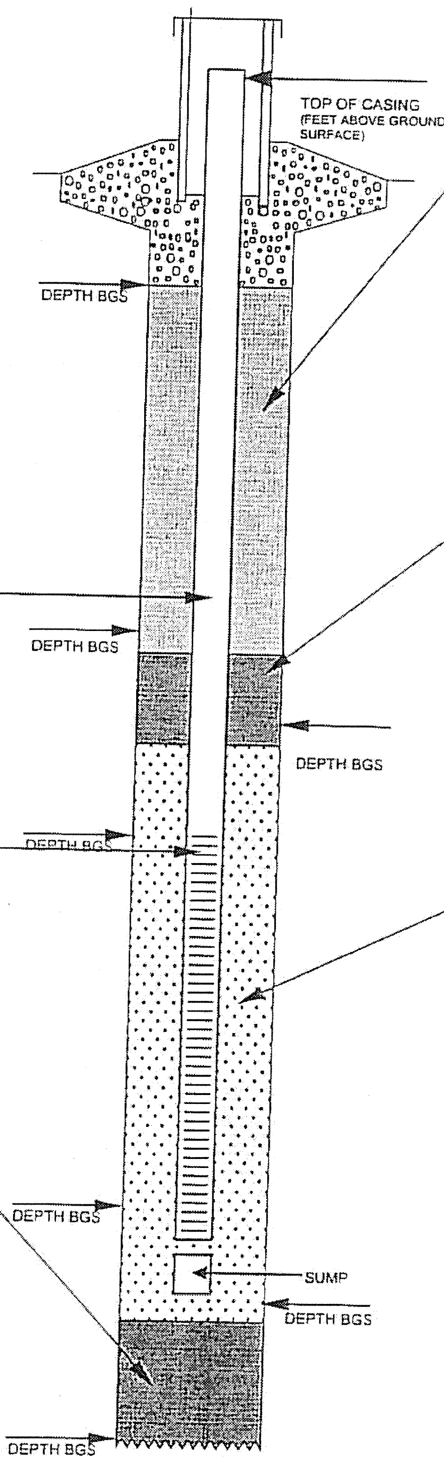
☐ SCHEDULE 40 PVC
☐ OTHER: ____________
PRODUCT: ____________
MFG. BY: ____________
CASING DIAMETER:
ID: ________ OD: ________
SLOT SIZE: ____________
LENGTH OF SCREEN: ____________

BOREHOLE BACKFILL

AMOUNT CALCULATED: ____________
AMOUNT USED: ____________
☐ BENTONITE CHIPS, SIZE: ____________
☐ BENTONITE PELLETS, SIZE: ____________
☐ SLURRY: ____________
☐ FORMATION COLLAPSE: ____________
☐ OTHER: ____________
PRODUCT: ____________
MFG. BY: ____________
METHOD INSTALLED:
☐ POURED ☐ TREMIE
☐ OTHER: ____________

SURFACE COMPLETION

☐ FLUSH MOUNT
☐ ABOVE GROUND WITH BUMPER POST
☐ CONCRETE ☐ ASPHALT



SURVEY INFORMATION

TOC ELEVATION: ____________
GROUND SURFACE ELEVATION: ____________
NORTHING: ____________
EASTING: ____________
DATE SURVEYED: ____________
SURVEY CO.: ____________

ANNULAR SEAL

VOLUME CALCULATED: ____________
AMOUNT USED: ____________
☐ GROUT FORMULA (PERCENTAGES)
PORTLAND CEMENT: ____________
BENTONITE: ____________
WATER: ____________
☐ PREPARED MIX
PRODUCT: ____________
MFG. BY: ____________
METHOD INSTALLED:
☐ POURED ☐ TREMIE
☐ OTHER: ____________

BENTONITE SEAL

VOLUME CALCULATED: ____________
AMOUNT USED: ____________
☐ PELLETS, SIZE: ____________
☐ CHIPS, SIZE: ____________
☐ OTHER: ____________
PRODUCT: ____________
MFG. BY: ____________
METHOD INSTALLED:
☐ POURED ☐ TREMIE
☐ OTHER: ____________
AMOUNT OF WATER USED: ____________

FILTER PACK

☐ PREPACKED FILTER
VOLUME CALCULATED: ____________
AMOUNT USED: ____________
☐ SAND, SIZE: ____________
PRODUCT: ____________
MFG. BY: ____________
METHOD INSTALLED:
☐ POURED ☐ TREMIE
☐ OTHER: ____________
WATER LEVEL: ____________
(BTOC AFTER WELL INSTALLATION)

CENTRALIZERS USED?

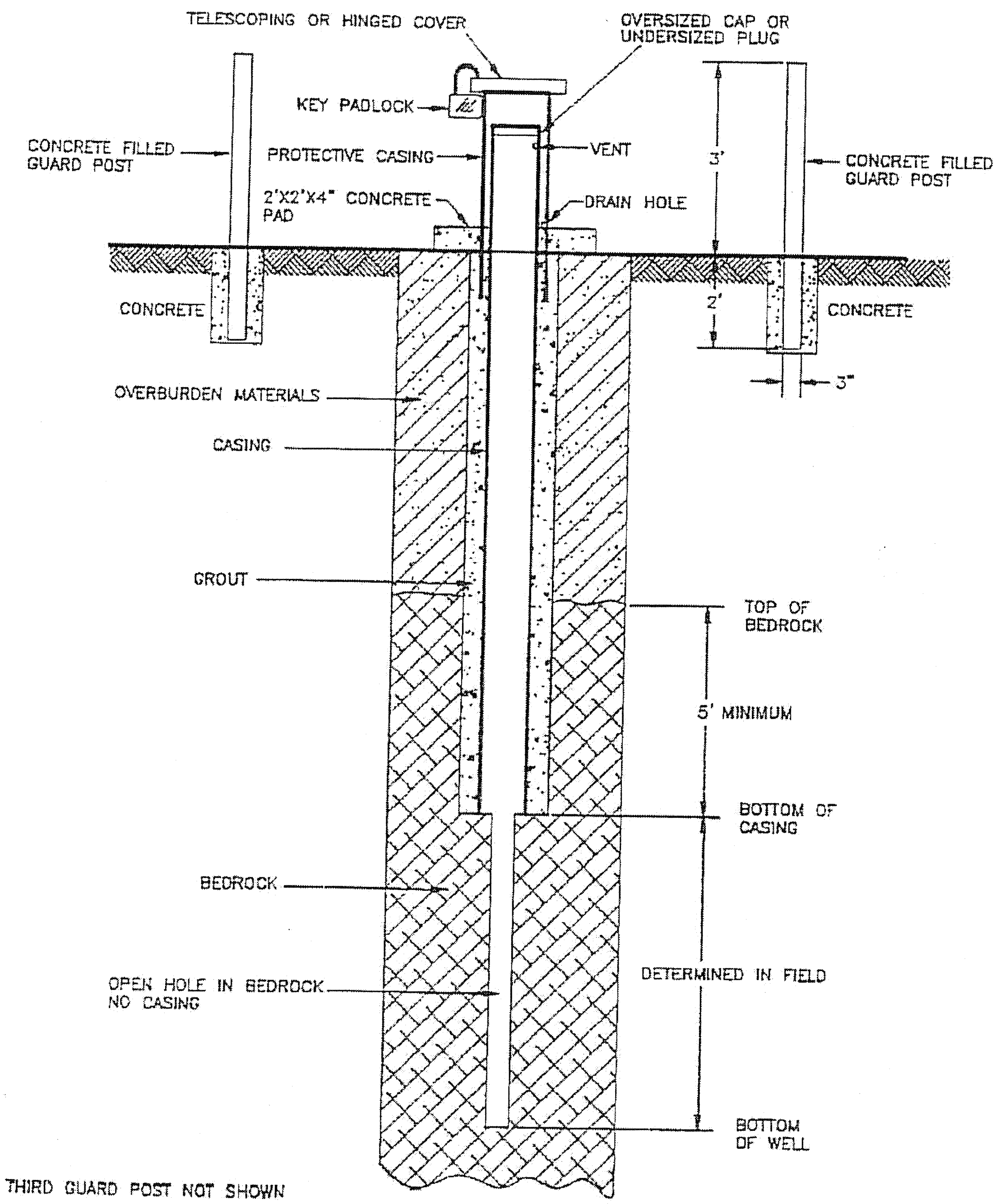
☐ YES ☐ NO:
CENTRALIZER DEPTHS: ________ ________

LEGEND

BGS = BELOW GROUND SURFACE
BTOC = BELOW TOP OF CASING
N/A = NOT APPLICABLE
NR = NOT RECORDED
TOC = TOP OF CASING

FIGURE 2

TYPICAL BEDROCK WELL CONSTRUCTION



SOP APPROVAL FORM

THE PRESIDIO TRUST

ENVIRONMENTAL STANDARD OPERATING PROCEDURE

MONITORING WELL DEVELOPMENT

SOP NO. 005

REVISION NO. 00

Last Reviewed: December 2000

Quality Assurance Approved

12 JAN 01

Date

1.0 BACKGROUND

Well development should be conducted as an integral step of monitoring well installation to remove the finer-grained material, typically clay and silt, from the geologic formation near the well screen and filter pack. Monitoring well installation is discussed in standard operating procedure (SOP) No. 004. Well development improves the hydraulic connection between water in the well and water in the formation. The fine-grained particles may interfere with water quality analyses and alter the hydraulic characteristic of the filter pack and hydrologic unit adjacent to the well screen.

All drilling methods impair the ability of an aquifer to transmit water to a drilled hole. Typically, this impairment is a result of disturbance of soil grains (smearing) or the invasion of drilling fluids or solids into the aquifer during the drilling process. Nonetheless, the impact to the hydrologic unit surrounding the borehole must be remediated if the well hydraulics and sampling of the monitoring well are to be representative of the aquifer.

1.1 PURPOSE

This SOP establishes the requirements and procedures for monitoring well development.

Well development improves the hydraulic characteristics of the filter pack and borehole wall by performing the following functions:

- Reduce the compaction and the intermixing of grain sizes produced during drilling by removing fine material from the pore spaces.
- Remove the filter cake or drilling fluid film that coats the borehole, and remove much or all of the drilling fluid and natural formation solids that have invaded the formation.
- Create a graded zone of sediment around the screen, thereby stabilizing the formation so that the well can yield sediment-free water.

1.2 SCOPE

This SOP applies to the specifications and methodologies of monitoring well development.

1.3 DEFINITIONS

Aquifer: A geologic formation, group of formations, or part of a formation that is saturated, and is capable of storing and transmitting water.

Bailer: A cylindrical sampling device with valves on either end used to extract water from a well. Bailers are usually constructed of an inert material such as stainless steel or polytetrafluoroethylene (Teflon®). The bailer is lowered and raised by means of a cable that may be cleaned and reused or by disposable rope.

Conductance (Specific): A measure of the ability of water to conduct an electric current. It is related to the total concentration of ionizable solids in the water. It is inversely proportional to electrical resistance.

Drilling Fluid: A fluid (liquid or gas) that may be used in drilling operations to remove cuttings from the borehole, to clean and cool the drill bit, and to maintain the integrity of the borehole during drilling.

Hydraulic Conductivity (k): The volume of water that will move in unit time under unit gradient through a unit area measured at right angles to the direction of flow.

Hydrologic Units: Geologic strata that can be distinguished based on the capacity to yield and transmit fluids. Aquifers and confining units are types of hydrologic units. Boundaries of a hydrologic unit may not necessarily correspond with laterally or vertically to lithostratigraphic formations.

Oil Air Filter: A filter or series of filters placed in the air-flow line from an air compressor to reduce the oil content of the air.

Oil Trap: A device used to remove oil from the compressed air discharged from an air compressor.

Riser: The pipe extending from the well screen to or above the ground surface.

Static Water Level: The elevation of the top of a column of water in a monitoring well or piezometer that is not influenced by pumping or conditions related to well installation, hydrologic testing, or nearby pumpage.

Transmissivity (T): The rate at which water is transmitted through a unit width of the aquifer under a unit hydraulic gradient. (Note: It is equal to an integration of the hydraulic conductivities across the saturated part of the aquifer perpendicular to the flow paths.)

Well Screen: A filtering device used to retain the annular filter pack materials; usually a cylindrical pipe with openings if a uniform width, orientation, and spacing.

Well Screen Jetting (Hydraulic Jetting): A means of well development, whereby a jetting tool comprising a perforated pipe connected to a high pressure pump, water is forced outwardly through the screen under pressure into the filter pack, and sometimes into the adjacent geologic unit.

1.4 REFERENCES

Aller, L. 1989. *Handbook of Suggested Practices for the Design and Installation of Groundwater Monitoring Wells*. National Well Water Association.

American Society for Testing and Materials (ASTM). 1989. "Proposed Recommended Practice for Design and Installation of Groundwater Monitoring Wells in Aquifers." *Annual Book of ASTM Standards*. Philadelphia, Pennsylvania.

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Driscoll, F.G. 1986. *Groundwater and Wells*. Second Edition. Johnson Division, UOP, Inc. St. Paul, Minnesota.

1.5 REQUIREMENTS AND RESOURCES

There are various options available to develop monitoring wells. The procedures and equipment required are outlined in the following sections.

2.0 PROCEDURES

Methods of well development vary with the physical characterization of hydrologic units in which the monitoring well is screened and with the drilling method used. The most common methods of well development include mechanical surging, pumping or overpumping, airlift pumping, backwashing, and jetting. These methods may be effective alone or may need to be combined (for example, mechanical surging and overpumping). Factors such as well design and hydrogeologic conditions will determine

which well development method will be the most practical and cost effective. The most common and effective methods of well development are described in Sections 2.1 to 2.2.

A well development datasheet (Attachment A) can be used to document site-specific data.

2.1 MECHANICAL SURGING

The mechanical surging method forces water to flow in and out of the well screen by operating a plunger (or surge block) or bailer in the casing, similar to a piston in a cylinder. The surge block is typically attached to a drill rod or drill stem and is of sufficient weight to cause the block to drop rapidly on the down stroke, forcing water contained in the borehole into the aquifer surrounding the well. In the recovery stroke or upstroke, water is lifted by the surge block, allowing the flow of water and fine sediments back into the well from the aquifer.

The surge block should be lowered into the well to 10 to 15 feet beneath the static water level and above the well screen, depending on the hydrologic conditions of the aquifer. The water column will effectively transmit the action of the block to the filter pack and hydrologic unit adjacent to the well screen. The initial surging action should be relatively gentle, allowing any material blocking the screen to break up, go into suspension, and then move into the well. As water begins to move easily both in and out of the screen, the surging tool is usually lowered in increments to a level just above the screen. As the block is lowered, the force of the surging movement should be increased. In wells equipped with long screens, it may be more effective to operate the surge block in the screen to concentrate its actions at various levels. Development should begin above the screen and move progressively downward to prevent the tool from becoming sand locked in the well. Periodically a pump or bailer should then be used to remove dislodged sediment that may have accumulated at the bottom of the well during the surging process.

Surging can disturb the formation and or filter pack, altering the hydraulic properties of these units. In formations with high clay and silt contents, surging can cause the screen to become clogged with fines. In all applications, surging should be used with caution to prevent casing and screen damage.

2.2 OVERPUMPING

Overpumping involves pumping the well at a rate substantially higher than it will be pumped during well purging and groundwater sampling. This method is most effective on coarse-grained formations. Overpumping is commonly implemented by using a submersible pump. In cases where the water table is less than 30 feet from the top of the casing, it is possible to overpump the well with a centrifugal pump. The intake pipe is lowered into the top of the water table and water is extracted.

Withdrawal of water from the top of the water table results in the same inflow at the screen as is achieved with a submersible pump. Either method of overpumping will induce a high velocity water flow, resulting in the flow of sand, silt, and clay into the well; clogged opening screen slots; and cleaning formation voids and fractures. The movement of these particles at high flow rates should eliminate particle movement at the lower flow rates used during well purging and sampling. The bridging of particles against the screen, because of the flow rate and direction created by overpumping, may be overcome by using mechanical surging or backwashing in conjunction with this method.

Effective overpumping involves the discharge of large amounts of groundwater. This may be a problem where groundwater extracted during well development is contaminated with hazardous constituents.

3.0 OVERALL CONSIDERATIONS

Other methods of well development are also available. For small-diameter and small-volume wells, a bailer can be used in place of a submersible pump in the overpumping method. Similarly, a bailer can be used in much the same fashion as a surge block in small-diameter wells. Wells can be backwashed by simply adding water to agitate and remove fines plugging the screen and formation.

3.1 INITIATION OF WELL DEVELOPMENT

Regardless of the well development method selected, a few considerations, which are universally applicable, should be considered. First, well development should not be initiated within 48 hours of grouting, and should be completed within 1 week of drilling. As flow is established through the intake portion of the well, the degree of agitation can be slowly increased. Second, there should be no time limit placed on well development. Well development should be considered complete when the flow is reasonably clear and free of sediment and when pH, temperature, and specific conductivity have

stabilized. This threshold should be rechecked at least once after letting the well sit undisturbed until it has achieved 95 percent water elevation recovery. These considerations are described in detail in the "Proposed Recommended Practice for Design and Installation of Groundwater Monitoring Wells in Aquifers" (ASTM 1989).

3.2 WELL DEVELOPMENT FACTORS TO BE CONSIDERED

An important factor in any method is that the development work be started slowly and gently and that it be increased in vigor as the well is developed. Most methods of well development require the application of sufficient energy to disturb the filter pack, thereby freeing the fines and allowing them to be drawn into the well. The coarser fractions then settle around and stabilize the screen.

Development procedures for wells completed in fine sand and silt strata should involve methods that are relatively gentle, so that the strata material will not be incorporated into the filter pack. Vigorous surging for development can produce mixing of the fine strata and filter pack and produce turbid samples from the installation. In addition, development methods should be carefully selected based on the potential contaminant present, quality of wastewater generated, and requirements for containerization or treatment of wastewater.

For small-diameter and small-volume wells, a bailer can be used in place of a submersible pump in the pumping method. Similarly, a bailer can be used in small-diameter wells in much the same fashion as a surge block.

Wells can be backwashed by simply adding water to agitate and remove fines plugging the screen and formation.

Any time an air compressor is used, it should be equipped with an oil-air filter or an oil trap to minimize the introduction of oil into the screen area. The presence of oil would impact organic constituent concentrations of the water samples.

3.3 DURATION OF WELL DEVELOPMENT

Well development should begin after the monitoring well is completely installed and before water sampling begins. Development should be continued until representative water, free of the drilling fluids, cuttings, or other materials introduced during well construction, is obtained. Representative water is